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Please Return To: James Dunn
DNR - NWD
Spooner, WI
54801

(715) 635 4049

Ashland Lakefront Property

Remedial Investigation Interim Report

Ashland, Wisconsin

SEH No. WIDNR9401

August 1994

SHORT ELLIOTT HENDRICKSON INC.

MULTIDISCIPLINED.
SINGLE SOURCE.

SEH

421 FRENETTE DRIVE CHIPPEWA FALLS WI 54729 715 723-8506 800 472-5881
ARCHITECTURE • ENGINEERING • ENVIRONMENTAL • TRANSPORTATION

August 22, 1994

RE: Ashland Lakefront Property
Remedial Investigation
Interim Report
SEH No. WIDNR9401

Mr. James R. Dunn, Hydrogeologist
Wisconsin Department of Natural Resources
Highway 70 West, P.O. Box 309
Spooner, WI 54801

Dear Mr. Dunn:

Short Elliott Hendrickson Inc. (SEH) is submitting six copies of the enclosed report titled, "Remedial Investigation Interim Report – Ashland Lakefront Property". This report is the first of three submittals to be completed for the project, in accordance with our June 22, 1994 agreement with the Wisconsin Department of Natural Resources (WDNR). The remaining two submittals (Existing Conditions Report, Treatability Study/Remedial Action Plan Report) are scheduled to be completed in October and December 1994, respectively.

SEH appreciates the opportunity to provide WDNR with environmental services on this project. If you have any questions pertaining to the Interim Report or to additional investigative activities scheduled for the project, please contact me.

Sincerely,

Cyrus L. Ingraham

Cyrus Ingraham, P.E.
Project Manager

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Remedial Investigation Interim Report

Ashland Lakefront Property
Ashland, Wisconsin

Prepared for:
Wisconsin Department of Natural Resources – Northwest District
Spooner, Wisconsin

WISCONSIN PROFESSIONAL ENGINEER
CYRUS W. INGRAHAM III
E-24690
CHIPPEWA FALLS, WI

Prepared by:
Short Elliott Hendrickson Inc.
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I, Cyrus Ingraham, hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch. A-E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

Cyrus W. Ingraham

Cyrus Ingraham, P.E.
Project Manager

I, John E. Guhl, hereby certify that I am a Hydrogeologist as that term is defined in s. NR 712.03(1) Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

John E. Guhl

John E. Guhl, C.P.G.
Hydrogeologist

I, Gloria Chojnacki, hereby certify that I am a scientist as that term is defined in s. NR 712.03(3), Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

Gloria Chojnacki

Gloria Chojnacki
Environmental Scientist

I, Darrell Reed, hereby certify that I am a Hydrogeologist as that term is defined in s. NR 712.03(1) Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

Darrell Reed

Darrell Reed, C.P.G.
Hydrogeologist

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Ashland Lakefront Property

Ashland, Wisconsin

1.0 Introduction

Short Elliott Hendrickson Inc. (SEH) has prepared a Remedial Investigation Interim Report for the Ashland Lakefront Property in Ashland, Wisconsin. The property is located along Chequamegon Bay between Ellis Avenue and Prentice Avenue in Ashland, Wisconsin. The ongoing Remedial Investigation (RI) of the property is being performed for the Wisconsin Department of Natural Resources (WDNR) under an agreement with SEH dated June 22, 1994. The RI will include two future submittals (Existing Conditions Report, Treatability Study/Remedial Action Plan Report) with investigation activities to be completed in December 1994.

1.1 Purpose

Subsurface contamination has been identified at the Ashland Lakefront site during past excavation activities and during past investigations of the property performed by Northern Environmental Technologies, Inc. (Northern Environmental) in 1989 and 1991. To-date, the full nature, extent, and sources of contaminants have not been identified. The purpose of SEH's RI is to identify the nature, extent, and potential source(s) of contaminants in soils and groundwater at the Ashland Lakefront property, as well as the evaluation of potential remedial technologies for the property.

1.2 Scope of Work

The scope of work for the RI was divided into the following three primary tasks.

Task 1: Site Characterization

Task 2: Field Investigation (including soil borings, monitoring well installation, test pit excavation, soil and groundwater analysis, and report preparation)

Task 3: Treatability Study and Remedial Action Plan preparation

This report summarizes the results of the site characterization (Task 1). Activities performed during site characterization included:

- Historical review of the vicinity to identify past and present land use and property ownership, and potential sources of on-site contaminants.
- Topographic survey and site observations of the property.
- Geophysical survey to characterize subsurface conditions at the property.
- Background groundwater sampling and analysis of three existing monitoring wells and one artesian well on the property.

The results of site characterization will be used to identify potential environmental concerns and to assess the potential for off-site contamination. Locations of proposed soil borings, monitoring wells and test pits, as well as analytical parameters were based in part on the results of the site characterization.

1.3 Project Contacts

1. James R. Dunn, Hydrogeologist
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   Spooner, WI 54801
   (715) 635-4049
2. Cyrus W. Ingraham, Project Manager
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2.0 General Site Description

The Ashland Lakefront property is located in Section 33, Township 48 North, Range 4 West in Ashland County, Wisconsin as shown in Figure 1, "Site Location Map". The latitude and longitude of the property is 46°35'41" North and 90°53'01" West. The property is approximately ten acres in size, and is currently vacant with no street address. The property is owned by the City of Ashland.

The Ashland Lakefront property is located generally east of the intersection of Ellis Avenue and Marina Drive in the City of Ashland. The property is bounded to the north by Chequamegon Bay, to the east by Prentice Avenue and vacant park land and boat parking areas, to the south by the Wisconsin Central Rail Line, with a bluff and residential dwellings located across the way, and to the west by Ellis Avenue and a pier and breakwater with adjacent boat slips. Businesses in the immediate vicinity include the Chequamegon Hotel (one block southwest of property), the Lake Aire Motel (one block south of the property), and the Northern States Power Company (NSP) offices (one block southeast of property).

Topography of the property is relatively flat, with a gentle slope to the northwest towards Chequamegon Bay as shown in Figure 2, "Site Plan". A 30 foot bluff is located along the south property line. A majority of the property is currently maintained as grass lawn. More dense brushy vegetation is present on the south side of the property. A boat parking lot is located on the southwest side of the property. The former City of Ashland Wastewater Treatment Plant (WWTP) facility is located on the northeast corner of the property. Marina Drive runs in an east-west direction through the property. Riprap comprised largely of concrete debris is located along the shoreline of Chequamegon Bay.

3.0 Historical Review

SEH performed a survey of past land use and ownership of the subject property and pertinent properties in the vicinity. A detailed review was performed on the area within two city blocks south of the property. The purpose of this phase of the project was to identify the potential source(s) and types of previously identified contamination in order that a work plan could be developed to effectively investigate and remediate the property, if necessary. The survey included the gathering of historical maps, photographs and documents focusing on industrial properties in the specified area in order to gain an understanding of raw materials and waste products which could have historically impacted the property and surrounding area.

3.1 Sanborn Map Review

Historical Sanborn Fire Insurance Maps were reviewed from the period of 1886 through 1951. Sanborn Maps labeled 1884 and one labeled 1886 were also reviewed. However, it is our opinion that these particular maps did not include the subject property area based on shoreline and topographic characteristics and, therefore, will not be included. The maps evaluated were separated into two general areas, the Ridge Top and Lower Fill Area. The Ridge Top included the offsite area approximately two city blocks south of the subject property, while the Lower Fill Area included the subject property. Copies of the historical Sanborn Maps can be found in Appendix A, "Sanborn Maps". The following features were noted during the Sanborn Map review:

1886 - Ridge Top
Ashland Lighting Co. Gas and Light Works is located at the corner of N. Prentice Avenue and St. Clair Street. A ravine extends south parallel to N. 3rd Avenue (Stuntz Avenue) through the Ashland Lighting Co. Gas and Light Works property to E. Front Street (now West Lake Shore Drive). One naphtha tank is located in the ravine. One gas holder, one horizontal boiler and various buildings exist on the property. No other industries were shown on the ridge top area on this map.

1890 - Lower Fill Area
W.R. Sutherland Saw and Planing Mill and Lumber Yard is located on the subject property north of the Wisconsin Central railroad tracks. The lumber yard has one dock extending north into Chequamegon Bay. The subject property is filled to approximately 150 feet west of North 3rd Avenue. Three trestle tramways are shown west of the saw mill on the fill area.

1890 - Ridge Top
Ashland Light Co. Gas and Electric Light Works is located at the top of the ridge. The ravine on the 1886 map is filled to a point approximately 60 feet south of St. Clair Street. A bridge crosses the ravine on St. Clair Street. Two underground naphtha oil tanks are shown at the bottom of the ravine approximately 125 feet east of N. 3rd Avenue. Retorts, two gas holders, three horizontal boilers and buildings for engines, coal and storage are labeled. No other industries were shown on the ridge top area on this map.

1895 - Lower Fill Area
Fill area on the subject property extends further west to N. 2nd Avenue and further north into the bay near the dock. A channel divides the recently filled area to the north from the mainland. The W.R. Sutherland Lumber Co. is located on the lower fill area. The Planing Mill has been moved from the east to the west side of the yard.

1895 - Ridge Top

The ravine appears to be filled to St. Clair Street. One "in ground" naphtha tank appears at the top of the ridge next to the Gas Furnaces and Purifiers building at the Ashland Lighting and Street Railroad Company. Buildings have been added on the east end of the site, and one gas holder is located near the alley next to the Street Car House, the second gas holder is no longer present. No other industries were shown on the ridge top area on this map.

1901 - Lower Fill Area

Fill area extends further west to the "Commercial Dock" on N. Ellis Avenue. The area is now occupied by the John Schroeder Lumber Company. Two lumber docks are located on the extension of N. Prentice Avenue. The saw mill is located where the former WWTP facility is presently. The mill is noted as being built in 1897. Various other buildings relating to the working of lumber are located on the property. A trench is located on the west portion of the site extending through the fill to the bay. The ground is noted as consisting of sa dust and slabwoo.

1901 - Ridge Top

The ravine has been filled to the north side of St. Clair Street based on the fact that a bridge no longer appears on St. Clair Street. The Ashland, Light, Power and Street Railroad Company buildings remain much the same as in 1895; however, two gas holders are now on site. Gas furnaces and purifiers have been rearranged. A Blacksmith and Carriage Shop is located along N. 3rd Avenue. No other industries were shown on the ridge top area on this map.

1909 - Lower Fill Area

The Schroeder Lumber Company Mill appears to be in the same location as in 1901. The Planing Mill in the south central portion of the property has been removed. A log slide is noted extending into the Bay from the mill at the point where several large concrete foundations are currently located. An oil house is located northwest of the mill. The two lumber docks are noted as having burned on August 21, 1909.

1909 - Ridge Top

The ravine continues to be filled from the south. Buildings at Ashland Light, Power and Street Railroad Company remain unchanged from 1901. Uses of some of the buildings have changed. The naphtha oil tanks remain in the same location. The Blacksmith Shop located along N. 3rd Avenue is now labeled as a Car Barn. No other industries were shown on the ridge top area on this map.

1923 - Lower Fill Area
Buildings on the John Schroeder Lumber Company property have been expanded. A machine shop and 40,000 gallon water tank have been added. The lumber docks (2) have been rebuilt. The trench located in the western portion of the property is labeled as an open sewer which runs through filled ground.

1923 - Ridge Top
The ridge line remains the same as that in 1909. Building configuration at the Lake Superior District Power Company (LSDP) remains the same. Two buildings on the west end of the site have been removed since 1909. The Generator and Purifying House is labeled as the Gas Plant (Water Gas Process). The naphtha tanks are labeled as gasol. tanks. The coal gas plant located in the northeast corner is no longer in use. Four horizontal boilers in the easternmost building have been reduced to one and its location has shifted. The LSDP facility extends to N. 3rd Avenue and the Car Barn in the southwest corner has been removed. No other industries are shown on this map.

1946 - Lower Fill Area
Buildings and features of the John Schroeder Lumber Company remain the same as on the 1923 map; however, it is stated that all docks, buildings, tramways and lumber piles have been removed. The open sewer trench remains.

1946 - Ridge Top
The ridge line is unchanged. The buildings on the eastern portion of the LSDP property have been expanded somewhat to the west. Two buildings on the west end of the property have been removed. A large gasometer has been constructed on the southwest corner of the property and the smaller gasometer in the south central area has been removed. The gasol. storage tank area has been moved south from next to the Generator/Purifying House to between the gasometers. Street car storage and repair is no longer done on this property and the northeast corner of the property is again labeled as a water gas plant. No other industries were shown on the ridge top area on this map.

1951 - Lower Fill Area
The map is a reproduction of the 1946 map with all features from the Schroeder Lumber Company hand deleted. No other uses of the subject property are shown on this map.

1951 - Ridge Top

The ridge line is unchanged. The Gasometer in the south central portion of the property has been removed. All other features of the LSDP property remain the same as in 1946. No other industries are shown on this map.

3.2 Historical Photograph Review

Historical photographs of the subject property were reviewed and compared for information regarding previous site activities and surrounding land use. The Wisconsin Department of Transportation (WDOT) provided a copy of a 1939 aerial photograph of the City of Ashland. The scale of the photograph is 1 inch equals 600 feet. The John Schroeder Lumber Company mill remains on the subject property. Two rail sidings traverse the property from the east and west and terminate at the locations of the former Commercial and Schroeder Docks. The remaining portions of the subject property appear to be vegetated. The gasometers and other structures associated with the LSDP gas plant are shown.

The WDNR - Brule Area office provided copies of aerial photographs for the year 1951 and a later unknown year. The scale is 1: 20,000. The 1951 photograph reveals that the site is vacant with no structures located on the subject property. Small trees and brush exist between the railroad tracks and the shoreline. An access road traverses the subject property to the north. The large gasometer noted on the 1946 and 1951 Sanborn Maps located on the LSDP Gas Plant site is visible approximately one city block south of the subject property.

The other aerial photograph was taken at a later date based on the fact that the former WWTP has been constructed on the subject property. The plant and sludge pads are visible along the shoreline north of the access road. A disturbed area exists south of the access road that could indicate earth work or filling. No vegetation is noted in the disturbed area. The gasometer at the LSDP Gas Plant site one block south of the subject property has been removed and a large building is constructed in its place.

A historical photograph of the Schroeder Lumber Company taken by Gib Westman of the Daily Press newspaper was viewed at the Vaughn Library located in Ashland, Wisconsin. This photograph revealed stacks of what appears to be railroad ties located at the Schroeder facility. No article accompanied the photograph.

3.3 Historical Document Review

3.3.1 Port and Terminal Facilities

The United States Army Corps of Engineers provided access to two volumes of the Minnesota/Wisconsin Ports on Lake Superior Series. The volumes reviewed were for the years 1945 and 1949.

Both volumes indicate that the Port of Ashland included seven commercially available dock facilities. Three of these docks were for receiving coal, three were ore shipping terminals, and one was used for handling pulpwood and saw logs. The dock used for the receipt of pulpwood and saw logs was known as the "Commercial Dock" and was operated by the Consolidated Water Power and Paper Company. This dock was located adjacent to the subject property to the west and is currently occupied by the Ashland Marina.

The docks associated with the lumber mills historically located on the subject property were dismantled by the time the Harbor Series documents were published. The records indicate that for the five year period from 1944 to 1948 the following average tonnages of iron ore, coal and pulpwood were handled at the Ashland docks:

Iron Ore	2,677,472 short tons
Coal receipts	312,908 short tons
Pulpwood	69,154 short tons

Pulpwood was transferred by a log conveyor directly into railroad cars for shipment to paper mills and ultimate conversion to paper. Very little unmanufactured lumber, timber, and wood was received at Ashland by 1944.

3.3.2 Former WWTP Plans

An original blue print plan of the former Ashland WWTP dated 1951 and produced by Greeley and Hansen Engineers, Chicago, Illinois, was reviewed for areas of potential contamination at the subject property. An area labeled "Coal Tar Dump" exists approximately 70 feet south of the southernmost outside wall of the preliminary sedimentation tanks. A 12 inch corrugated pipe extends from the "Coal Tar Dump" area northwest to the shoreline.

A July 26, 1994 interview with John Skatch of Greeley and Hanson Engineers indicates that no information regarding the "Coal Tar Dump" could be found in their records. A copy of the plan is provided in Appendix B, "Greeley and Hansen 1951 Site Plan".

3.3.3 History of John Schroeder

A document entitled "A History of John Schroeder and the John Schroeder Lumber Company, Milwaukee, Wisconsin" (1990) written by the Forest Resource Center, Lanesboro, Minnesota, was reviewed for historical information regarding the lumber industry operations located on the subject property. The document provides a chronological historical recording of John Schroeder and the lumber industry which he founded. The company had many holdings and several facilities, one of which was located in Ashland, Wisconsin.

Several references were made in the document to the manufacturing of railroad ties; however, no mention was made to the preservation of the ties. It is important to note that the main focus of the document was not the detailing of daily operations at the Ashland facility and that most of the Ashland facility information is based on newspaper accounts.

3.4 Historical Site Occupancy

Based on a review of historical documents, photographs, and maps, the following chronology of occupancy was prepared for the subject property. A chain of title search of the subject property is being conducted. The results of this search will be presented as an addendum to this report.

Occupant	Date
Barber Mill	1884 - 1887
W.R. Sutherland Mill	1887 - 1897
Pope Lumber	1897 - 1901
John Schroeder Lumber Co.	1901 - 1936
Ashland County	1936 - ?
City of Ashland	? - Present

3.5 Northern Environmental Report

As part of a proposed expansion of the former WWTP facility, the City of Ashland contracted with Northern Environmental to conduct a feasibility study of the subject property. As part of this study, a report was prepared entitled "Environmental Assessment - City of Ashland, Wisconsin Wastewater Treatment Plant Site", dated August 21, 1989. A site history was presented in this report which indicated that prior to the 1920's, the subject property was occupied by the "Schrader" Sawmill. Reportedly, the sawmill manufactured railroad ties and timbers for dock construction. The ties and timbers were treated in a creosote pit reportedly located south of the former WWTP. The Northern Environmental report stated that the sawmill was closed and creosoting operations ceased in approximately 1920. The source of this information was not identified in the Northern report, nor could it be substantiated in subsequent telephone conversations between Northern and SEH personnel.

The former WWTP was constructed in 1951 on a foundation of pilings and concrete support structures. A clay core wall was constructed along the north and west plant boundaries to prevent lake water from infiltrating into the facility. Additions to the former WWTP were completed in 1973.

3.6 Site History

SEH conducted interviews with individuals familiar with the history of the subject property. Interviews were also conducted with individuals acquainted with historical processes associated with industries in the vicinity which could have contributed to contamination previously identified on the site. Many times the information conflicted. An attempt will be made to present the information in a chronological manner including opposing statements as they apply.

Prior to the 1900's and until 1936, the subject property was associated with the lumber industry. The property had been operated under various owners over the years. The last of whom was the John Schroeder Lumber Company from 1901 through 1936. In a conversation with Dave Wapeska, an employee of the City of Ashland Wastewater Treatment Department (including the former WWTP) since 1973, Mr. Wapeska stated that he understood there was a creosote pit associated with the Schroeder Sawmill. He thought the creosote pit had been used for the treatment of railroad ties which may not have treated wood regularly, but possibly on a "by-order" basis. Mr. Wapeska also stated that the City of Ashland filled the lower lying areas over the years with sawdust, fly ash, and other materials. The fill was placed south of the former WWTP. He did not personally observe any contamination.

Bob Klamerus, a city of Ashland Water Utilities employee, stated that his father was an employee of Schroeder Lumber Company. He thought there was a creosote treatment pit located just west of N. Prentice Avenue between the former WWTP and the railroad tracks.

Thomas Hubbard, a former resident of the City of Ashland, and LeRoy Lee, an Ashland resident and former utility board member stated that they understood that utility poles were treated in a creosote pit located south of the former WWTP.

No records regarding the treatment of wood at the subject property have been located; however, the interviews are supported by the fact that contamination containing chemical constituents resembling those found in raw creosote had been identified in the Northern Environmental report (August 1989). The historical newspaper photograph viewed at the Vaughn Library in Ashland, Wisconsin indicates that railroad ties were produced at the Schroeder facility.

The Railroad Tie Association (RRTA) located in Gull Shores, Alabama, was contacted regarding information on the practice of treating ties with creosote. The RRTA is a trade association which has been in existence since 1919 and maintains a current and past list of its members. The RRTA's membership list does not include the Schroeder Lumber Company as a member. In a discussion with the executive vice president of the American Wood Preservers Association (AWPA), John Hall, it was revealed that there were no wood preserving facilities operating in Wisconsin around 1920. This is based on a list of creosote preserving facilities contained in the "Proceedings on Creosote" by the AWPA. However, the completeness of these lists have not been verified.

Mr. Larry Wisner, City of Ashland Museum curator, stated that he had heard that contamination on the subject property was related to the historic manufactured gas plant (MGP) located on St. Clair Street, south of the site. This belief was also stated by Mr. John Walters, a local historian and former dock worker at the Consolidated Paper Company located west of the subject property on the "Commercial Dock".

The production of coal tar is a by-product of the manufacturing of gas from coal used in the early part of the 20th Century. This manufactured gas was used to heat and provide light to homes. Mr. John R. Dramm, an employee of the United States Department of Agriculture Forest Products Laboratory, Madison, Wisconsin, and Randall Baileys of Koppers Industries, Pittsburgh, Pennsylvania contributed information regarding historical and chemical composition of creosote and coal tars.

Coal tar bath treatment of lumber was found to be ineffective around the mid 1870's. In the late 1870's, creosote made from wood was produced for bridge piling. Eventually creosote produced as a distillate from coal tar was found to be effective and economical to produce. The earliest process of distilled creosote preservation of wood employed cold or hot dip treatment. Kevin Dickey, an employee of American Wood Preservers Institute stated that dip treating was conducted as late as the 1980's. Since creosote is a distillate of coal tar, the two products are very similar chemically.

In conclusion, there appears to be three potential sources for the identified contaminants found in the soil and groundwater at the subject site. One being wood preservation with raw coal tar, creosote or creosote-like materials at the various lumber companies historically located at the site. The second being MGP wastes disposed onsite from a nearby plant historically located approximately one block south of the site. The third potential contributor to the contamination may be fill and wastes placed by the City of Ashland or other parties during the various phases of use and development of the subject property. No substantiation of these sources in the form of documents, photographs, or maps have been located to date. In the event that new pertinent information becomes available at a future date, it will be presented in subsequent documents.

4.0 Geology and Hydrogeology

4.1 Regional Geology

According to the Wisconsin Geological and Natural History Survey (WGNHS), Pleistocene lake deposits belonging to the Miller Creek Formation occur beneath the native surface soil horizon. The Miller Creek is generally a red, silty clay which typically contains some gravel, pebbles, and cobbles. The Miller Creek Formation in the Ashland area ranges from approximately 15 to 50 feet in thickness based on a City of Ashland WGNHS geologic log, well drillers reports, and onsite soil borings. The Pleistocene-age, Copper Falls Formation is encountered beneath the Miller Creek and extends to at least 130 feet below grade. The Copper Falls Formation consists of interbedded glacial clays, sands, and gravels. Precambrian age bedrock has not been encountered in the immediate Ashland area, but is anticipated to occur several hundred to five hundred feet below grade. Precambrian age sandstone of the Oronto Group is likely to be the first bedrock unit encountered. A generalized stratigraphic column for the Ashland area is shown on Figure 3, "Stratigraphic Column".

4.2 Regional Hydrogeology

A shallow, perched water table is commonly found at the contact of the Miller Creek Formation with the surficial soils. This water table can be up to ten feet thick but is not commonly used as a water supply source. According to Zaporozec and Cotter, 1985, three types of aquifers occur in the Lake Superior Basin; the Pleistocene sand and gravel aquifer of the Copper Falls Formation, the Precambrian sandstone aquifer, and the Precambrian basalt aquifer.

Northern Environmental's 1991 investigation consisted of the excavation of three test pits to the south and east of the former WWTP. One composite soil/wood sample and one groundwater sample were collected from the test pits and analyzed for TCLP Cresol, VOCs, and polynuclear aromatic hydrocarbons (PAHs). These compounds were selected to investigate the possible presence of creosote.

Creosote usage on site was supported by the presence of BNA hydrocarbons typically found in raw creosote. Elevated concentrations of arsenic, chromium, copper and zinc were found in soil samples collected on site. These metals were attributed to wood preservation according to the Northern Environmental report.

Northern's conclusion of the contamination identified on the subject property may or may not be accurate. Metals such as aluminum, copper, zinc and others could be associated with MGP wastes; however, metal residuals in raw creosote would be at best, found in trace amounts. The presence of elevated concentrations at the subject site does not eliminate the possibility of wood preservation on site because preservation of wood using metal salts such as copper and zinc can be traced back to the Egyptians. The possibility of LSDP disposing of polychlorinated biphenyls (PCBs) was also posed; however, no documents were found to substantiate this and laboratory samples did not identify the presence of PCBs in the eastern portion of the subject property which was investigated at that time.

Northern Environmental's analytical results identified significant concentrations of VOCs and PAHs in site groundwater. The VOCs detected were largely the BTEX (benzene, toluene, ethylbenzene, and xylenes) compounds. The PAHs detected could be indicative of either creosote or coal gasification wastes.

6.0 Potential Contaminant Chemistry

SEH performed a preliminary evaluation of the chemical composition of the previously identified and potentially unidentified contamination on the site. The purpose of this evaluation was to identify potential sources of the known contamination based on chemical composition and to assist in the selection of analytical parameters for the proposed field investigation. Three potential sources of contamination were identified to-date through the historical review of the site. These include:

- The possibility that wood treatment occurred onsite using coal tar/ creosote compounds;

The sand and gravel aquifer of the Copper Falls Formation occurs from 25 to 55 feet below the surface in the Ashland area. Sandy till yields small amounts of water (5 to 10 gpm) while sand and gravel lenses can yield up to 100 gpm. Flowing artesian wells are common within the Copper Falls Formation in the Ashland and Bayfield Peninsula area. The artesian head results mainly from the restriction of vertical groundwater movement through the thick horizontally bedded "red clays" of the overlying Miller Creek Formation. Static heads of more than 30 feet above the level of Lake Superior have been reported near Chequamegon Bay.

The Precambrian sandstone aquifer is the primary water supply source for several nearby Bayfield Peninsula municipalities (e.g., Washburn, Bayfield). Moderate to low permeabilities exist within the sandstone. Yields from the sandstone aquifer can reach up to 500 gpm.

The Precambrian basalt aquifer produces moderate to low yields of groundwater. Yields are commonly controlled by fracture densities within the basalt. This aquifer is commonly used as a water supply source south of the Ashland area where it occurs closer to the surface.

4.3 Site Geology

The near-surface soils at the Ashland Lakefront property are comprised largely of various fill materials placed in the late 1800's and early 1900's. The fill materials were placed along the former shoreline of Chequamegon Bay, eventually extending the shoreline north from its former location approximately 400 feet. Fill materials identified at the property to-date include wood wastes, clay, silt, peat, and sand. Some areas impacted by heavy petroleum wastes within the fill have also been identified. Thickness of fill ranges from 10 feet to 14.5 feet in the portions of the property previously investigated. Lithologic descriptions of fill encountered in existing soil borings and test pits are presented on Figure 4, "Soil Boring/Test Pit Locations/Descriptions".

Fill soils at the property are underlain by 0 to 5.5 feet of sands and silty sand beach deposits, which are in turn underlain by lacustrine and glacial till units comprised largely of clays (Miller Creek Formation). The clay units extend to depths ranging from 26 feet to 56 feet below ground surface in borings previously performed on the property. The clay units are underlain by silty sand and gravel water-bearing glacial outwash and glacial till deposits (Copper Falls Formation) which were present to the maximum depth penetrated at the property (61 feet). No borings to bedrock have been performed on the property to-date.

4.4 Site Hydrogeology

A shallow perched water table is present at the property in fill materials and soils overlying the clay layer. Depth to groundwater ranged from 4.2 feet to 8.2 feet below ground surface. Groundwater elevation data from the three existing monitoring wells on the property is presented in Table 1, "Summary of Groundwater Elevation Data". Based on SEH's initial round of groundwater elevation readings, it appears direction of shallow groundwater flow is to the north-northwest (towards Chequamegon Bay). Additional groundwater elevation data will be required to verify direction of shallow groundwater flow and to determine hydraulic gradients. This information will be obtained during the next phase of the RI.

The deeper silty sand and gravel glacial outwash and glacial till units comprise an aquifer which is confined by the overlying clay layers (the clay layers act as an aquitard between the shallow perched aquifer and the deeper confined silty sand and gravel aquifer). The recharge zone for the deeper aquifer is in the hills south of Ashland. A strong upward hydraulic gradient is present in the deeper aquifer, with artesian conditions observed in wells screened in this unit. An artesian head of approximately 17 feet above existing ground surface was measured in an on-site artesian well during the Northern Environmental RI.

5.0 Previous Investigation

Past RI activities have been conducted by Northern Environmental in 1989 and in 1991 as part of a proposed expansion project for the former City of Ashland WWTP. Northern Environmental's investigation focused on creosote treatment of wood timbers reportedly conducted on the property prior to the 1920's. Northern Environmental's 1989 investigation included the drilling of eight soil borings of which three were subsequently instrumented as groundwater monitoring wells. Two soil samples collected by Northern Environmental were submitted for laboratory analysis. Analytical parameters included base, neutral and acid extractable compounds (BNAs), volatile organic compounds (VOCs), PCBs, arsenic, chromium, copper, and zinc. One round of groundwater samples was collected by Northern Environmental from the three monitoring wells during the 1989 site investigation. The groundwater samples were analyzed for BNAs, VOCs, PCBs, arsenic, chromium, copper, zinc, and several indicator parameters.

- The potential for onsite disposal or migration of wastes from offsite related to the operation of a historical manufactured gas plant; and,
- The disposal of various waste materials in the fill placed onsite through the long-term development and use of the site.

Previous analytical results have indicated the presence of VOCs, PAHs and metals. Many of these compounds are typically associated with one or more of the potential sources of contamination. The following subsections describe the chemical composition association with raw materials and wastes from each of the potential sources identified to-date.

6.1 Wood Treatment Compounds and Wastes

The subject property was used by the lumbering/wood products industry from the 1880's through the 1930's. The potential exists that some treating of wood products may have occurred during that time period. Research on the history of wood treating indicates that wood treating for preservation has changed throughout this time period and was unregulated with regard to specific material and treatment procedures.

In general, the early wood preservative methods included dipping or direct application of metallic salts and coal tar materials. The coal tar materials used were by-products generated from the manufacturing of coal gas and were not processed further prior to use. Many facilities utilized coal tar/kerosene mixtures. By 1930, true creosote was being actively distilled from coal tar to remove the volatile fraction (<210 degrees Celsius boiling point) and heavy oils (>450 degrees Celsius boiling point). The resulting true creosote is comprised primarily of 18 PAHs. These compounds are shown on Table 2, "Major Components in Creosote".

The components of creosote with boiling points below 210 degrees Celsius generally make up less than 2 percent of whole creosote. These components include VOCs and other aromatic hydrocarbons.

6.2 Manufactured Gas Plant By-Products and Wastes

The production of coal tar is a by-product of the coal carbonization and carburetted water gas (CWG) processes which were used in the manufacturing of gas in the early part of the 20th Century. Historic Sanborn Maps indicate that earlier processes at the St. Clair Street MGP used coal carbonization methods followed by a water gas process in later years.

Five waste streams and several chemicals of concern have been identified based on a survey of 33 MGP sites according to a Gas Research Institute document titled "Management of Manufactured Gas Plant Sites". A summary of the wastes and chemicals are shown on Table 3, "Wastes and Chemicals of Interest at MGP Sites". The list of chemicals includes only those compounds which are common at MGP sites and have regulatory significance (e.g. managed under EPA CLP or RCRA TCLP guidelines). It is important to recognize that the actual compounds identified in soil or groundwater at a specific site may vary from those shown on the table due to variation in feed stock, process waste characteristics (type, density, solubility, etc.), and residual management techniques.

6.3 Disposal of Waste Materials In Fill

Various waste materials have reportedly been disposed onsite by historical owners of the property and potentially unauthorized individuals. The site was constructed through the placement of fill materials at the base of the former lakeshore bluff from the 1870's (or earlier) until the 1970's. The majority of the fill materials reportedly included slabwood and sawdust. However, other reports indicate the disposal of municipal solid wastes, fly ash and earthen fill materials may have occurred in various areas.

The chemical composition of these materials or leachate from these wastes would depend upon several unknown factors. Therefore, a list of potential contaminants from the filling of the site cannot be developed based on current information.

6.4 Recommended Analytical Parameters

The proposed field investigation will include the collection of soil, groundwater, fill material, and surface water samples. The analytical parameters selected for the various media will be used for waste classification, comparison to regulatory action levels, and determination of potential sources of contamination. Analysis for the chemicals identified in Table 3 will allow for evaluation of contamination from the three potential sources identified to-date. The compounds commonly found in MGP wastes are made up, in part, by compounds found in creosote-type wood preservatives. In addition, many of the compounds found in Table 3 are also commonly associated with municipal solid waste, and fly ash.

Standard EPA analytical methods may not include all of the specific compounds in Table 3 as part of the standard analyte lists and, therefore, analysis for all compounds may be cost prohibitive. In addition, specifically for select metals and inorganics, the potential for these chemicals to be present at the site may be low and not warrant analysis. The specific recommended analytical methods are included in Section 8.0 of this report.

7.0 Preliminary Site Investigation

A preliminary site investigation of the Ashland Lakefront property was performed by SEH from June through August 1994. The preliminary site investigation was limited to nonintrusive field activities, and the results were used to develop a work plan for the subsequent phase of the investigation.

7.1 Topographic Survey and Site Observations

A detailed site survey was performed by SEH on the property in June 1994. The survey included site topography, site boundaries, structure locations, utilities, existing monitoring wells and artesian well, roadways, rail lines, and the existing shoreline of Chequamegon Bay. A site grid system was established to aid in location of field sampling points. Elevation data was recorded in Mean Sea Level (MSL) datum. The results of the site survey are presented on Figure 2.

The site was observed by SEH on June 28, 1994. A majority of the site is fairly level and vegetated with mowed grass. The southern portion of the site is overgrown with brush, with a bluff rising to the south. Site features (e.g., buildings, roadways) were observed as shown on Figure 2. During the site observation, a groundwater seep was identified on the south side of the property southwest of MW-2 and just north of the railroad tracks. An apparent sheen and possible odor was noted associated with the seep.

7.2 Geophysical Survey

7.2.1 Background

During the period of July 5 through July 9, 1994, electromagnetic and magnetic surveys were conducted by SEH's subcontractor, Fromm Applied Technology of Mequon, Wisconsin at the Ashland Lakefront Property. The geophysical program was intended to nonintrusively determine the presence of geophysically detectable buried metal and to delineate anomalous zones within the wood waste fill area.

7.2.2 Objectives

The objectives of the electromagnetic and magnetic surveys were to delineate geophysically detectable buried metal and to identify lateral variations of the fill material that may be associated with previous site material usage and waste disposal. The anomalous zones indicating buried metal could be associated with, but are not limited to, drum disposals, underground utilities, and sewer lines. The geophysical surveys were not intended to determine the limits of fill.

The objective of electromagnetic (EM31) survey was to map variances in apparent electrical conductivities and inphase responses in both the vertical and horizontal dipole modes. These variances are expected to delineate zones that differ from background. It was anticipated that the electromagnetic properties of landfilled material, large zones saturated with contaminants, and buried utilities would differ significantly from the properties of the native soils. Hence, the horizontal extent of these features should be defined by EM31 isopleth maps.

The objective of magnetic survey was to define the location of buried ferrous metal and to supplement the EM31 results. Magnetic methods are typically more sensitive to discrete ferrous metal objects at greater depths than are EM31 methods. It should be noted that the depth of investigation of the magnetic method is dependent on the size and geometry of the ferrous object(s).

A discussion of the instrumentation, theory and methodology used in conducting the geophysical surveys are incl. 'ed in Appendix C, "Fromm Applied Technology Report".

7.2.3 Geophysical Assumptions

There was a high level of confidence that EM31 and magnetometer measurements would delineate zones of interest within the fill area and detect relatively large buried utilities, assuming minimal cultural interference (i.e. buildings, fencing, and demolition debris). Neither of these methods were expected to deliver a high level of confidence or determine quantitatively the depth to a detected source material. The relationship between the horizontal and vertical dipole EM31 measurements are expected to qualitatively identify the thickness of the upper unsaturated fill material and to differentiate between zones of high conductivities (metals, clay soils) and low conductivities (organic contaminants). Buried metal is assumed to be near the surface, approximately less than ten feet, and large enough for the EM31 to detect. The success of the magnetometer survey is based on the presence of ferrous material, which is usually associated with landfills.

7.2.4 Grid System Layout

The rectangular coordinate system and ground control referenced at the site was established by SEH. The local coordinate system, measured in distance north and east, was established with the Y-axis pointing approximately 35 degrees west of north. The X-axis is measured in distance east and extends 1130 East to 2240 East. The

Y-axis is measured in distance north and extends from 1880 North to 2180 North. The discussions and figures presented in this report reference this coordinate system.

7.2.5 Results

The results of the EM31 and Magnetometer Surveys are summarized from the Fromm Applied Technology Report contained in Appendix C. The anomalous areas (AA) discussed in this report and shown on the enclosed figures, are referenced from the Fromm Applied Technology isopleth contour maps.

7.2.5.1 EM31 Survey

The results of the EM31 vertical and horizontal dipole mode surveys are presented on Figure 5, "EM31 Survey – Anomalous Areas Map". This figure represents a summary of the anomalous areas discussed and shown in the Fromm Applied Technology Report. A discussion of the anomalous areas indicated on Figure 5 follows:

AA #1 – Underground Utilities/Steel Building
The metal associated with underground utilities or drainage lines usually produces linearly trending negative conductivity contours. The generally north-south trending negative anomaly extending from 1820E 1880N to 1870E 2180N is an example of an interpreted utility. This anomaly may result from a water supply line to the former WWTP. The parallel negative anomaly from 1870E 1880N to 1910E 2100N is likely a buried utility line of unknown purpose. Either of these lines may join with another line extending from 1860E 2100N to the steel building located at 2220E 2030N. While this negative anomaly does break up, it is interpreted to be a continuous feature.

AA #2 – Culverts/Pipes
The short negative anomalies centered at 1270E 2100N, 1600E 2140N, and at 2130E 2140N result from visible steel culverts. The longer negative anomaly extending from 2190E 1880N to 2240E 2090N is also thought to result from a culvert. The negative inphase response at 1800E 1950N apparently results from a horizontal piece of 15 inch steel pipe.

AA #3 – Boat and Boat Trailer Area
Measurements in the southwest portion of the site were compromised by the presence of numerous boats and boat trailers. The area of compromised measurements appeared to extend in the north-south direction from 1900N to 2050N and from 1130E to 1430E.

AA #4 – Wood Waste-Free Area

The southern edge of the site is a heavily vegetated, topographic low near lake elevation. Based primarily on elevation, this area is assumed to be free of a significant wood waste layer. The apparent electrical conductivities south of 1900N, observed in the vertical dipole mode, are approximately 20 millimhos per meter. Hence, apparent conductivities, observed in the vertical dipole mode, in the range of 15 to 20 millimhos per meter are interpreted to be area background values and represent the absence of any wood waste.

AA #5 – High Soil Conductivity Area

Areas having high soil conductivities as interpreted by Fromm Applied Technology are shown on Figure 5. These anomalous areas are centered on grid locations 1650E 2030N, 2100E 2050N, and 1230E 2090N.

AA #6 – Low Soil Conductivity Areas

Areas of low soil conductivities are centered on grid locations 1380E 2150N, 1980N 1980E, 1730E 1910N, 1980E 1980N, 2080E 1920N, and 2180E 2150N. The small strip surveyed north of Marina Drive and possibly including the roadway may be constructed of material different than what composes the fill south of Marina Drive. The 40 foot wide zone from approximately 1130E to 1350E along 1980N is a relatively low conductivity zone with little indications of buried metal. As previously mentioned, the validity of the data is highly compromised by the presence of boats and parked trailers in this area. However, interpreting the data near 1180E 1980N may suggest the fill material is different from the center portion of the site.

AA #7 – Wastewater Treatment Plant (WWTP)

The inphase EM31 anomaly seen at 2000E 2150N is thought to be associated with the WWTP.

7.2.5.2 Total Magnetic Field Survey

The magnetic results are responding entirely to the presence of ferrous material and are independent of stratigraphic changes. The typical response is a maximum peak accompanied by an associated minimum trough. The magnitude and extent of the response reflects the size, depth, and orientation of the ferrous material. The results presented are typical for small and shallow ferrous objects.

The results of the Total Magnetic Field Survey are presented on Figure 6, "Magnetic Field Anomalous Areas Map". This figure represents a summary of the anomalous areas discussed and shown in the Fromm Applied Technology Report. A discussion of the anomalous areas indicated on the map follows.

AA #8 – Wastewater Treatment Plant (WWTP)
A large negative anomaly is centered at approximately 2020E 2130N. This anomaly appears to be related to the WWTP and may involve buried ferrous material outside the plant's foundations.

AA #9 – Artesian Well
The anomaly centered at approximately 2180E 1950N is very close to the public artesian well located on the property. However, the building is made of wood and the one inch well pipe is too small to account for the anomaly. It is possible that a very large well casing is producing the anomaly, but the presence of any casing was not confirmed.

AA #10 – Deep, Unknown Feature
The positive anomaly centered at 2160E 2140N has no clear and obvious source. The gradient at this location is low which implies that the source material is relatively deep.

AA #11 – Ferrous Materials Area
The total field magnetic results appear to divide the site into two distinct regions. West of the north-south line at approximately 1730E, the results are a chaotic set of isolated short wavelength events. The nature of the anomalies found in the western side of the site would suggest the presence of numerous small ferrous objects that are all shallow. While each of the anomalies in this area line indicate the presence of ferrous material, only modest concentrations appear evident. The area east of 1730E does not contain the small chaotic, isolated, and short wavelength anomalies that are clearly evident west of this line.

AA #12 – Underground Utility
The long, wide, linear north-south anomaly centered along 1890E is apparently an underground utility, which was better defined by the EM31 data. A trend is evident from 1950E 1880N towards 2110E 2050N. The source of this anomaly is unknown, but appears to contain higher conductivity soils and varying amounts of metal, including ferrous material.

7.2.6 Conclusions

7.2.6.1 EM31

The electrical conductivity surveys clearly defined a number of underground utility lines and culverts. The features are the linear trending AA #1 and AA #2 areas of Figure 5. The trends and, where possible, the origins of these features were discussed in the Results section. Other than the effects of the underground utility lines and culverts, the site can be electrically characterized with the EM31 vertical dipole data as consisting of areas with high apparent conductivities of 35 millimhos per meter or greater (AA #5), and areas with low apparent conductivities of 25 millimhos per meter or less (AA #6). The AA #6 low conductivity areas in the southeast section of the grid may be contiguous, but are separated by anomalous values that may result entirely from dominating underground utility lines (AA #1).

Qualitatively, the high (AA #5) and low (AA #6) conductivity areas differ significantly. On the basis of correlating the available boring logs with observed conductivities and assuming the wood waste is present throughout the site, it appears the conductivity of the wood waste is greater than the cover material. In addition, if it is assumed that the basal elevation of the fill material and the elevation of the water table remains fairly constant, it is highly probable that the varying conductivities are from a change in pore fluid conductivity, a change in the thickness of the cover material, or a combination of these two effects. Interpreting the first two effects independently yields the following possibilities:

1. Within the low conductivity areas (AA #6), organic fluids may be a significant part of the pore fluids associated with the wood waste. The presence of the non-conducting organic fluids would likely lower the bulk conductivity of the wood waste, which would serve to lower the measured apparent conductivities. Under these conditions, the previously noted low conductivity areas may represent the areas of highest organic contamination. The areas of high apparent conductivity (AA #5) may result from the presence of water saturated wood waste relatively free of organic contamination. The transition zones between the AA #5 and AA #6 areas may represent the transition between relatively clean and contaminated zones.
2. If the pore fluid conductivity does not change significantly, the observed results must be accounted for through a change in the thickness of the surface material, assuming the cover material is a low conductivity layer. Again, if the water table and basal elevation of the fill material are assumed constant, a decrease in conductivity is equivalent to a decrease in the thickness of wood

waste material. Areas of low conductivity would then imply an increase in thickness of the cover material. Areas of high apparent conductivity (AA #5) would imply a thin layer of cover material. The transition zones would result from areas of varying cover material thickness.

7.2.6.2 Total Magnetics

A combined interpretation of the total field and vertical gradient results would suggest that the content of ferrous metal in the fill material varies. West of approximately 1730E the surface material contains small randomly located pieces of ferrous material. Whereas, east of this line, ferrous material is apparently deeper or absent. The magnetics field data also verified the presence of buried ferrous underground utility piping, culverts, the steel building, and the surface features in the boat trailer storage area. A positive anomaly located near the former WWTP has a deep unknown source.

7.3 Groundwater Monitoring

One round of groundwater samples was collected by SEH on June 28, 1994. The samples were collected from the three existing monitoring wells and the on-site artesian well. In addition, a duplicate sample and a trip blank were collected for analysis. The wells were purged and the groundwater samples were collected from the monitoring wells using new disposable polyethylene bottom-discharge bailers and nylon string. The artesian well was not purged, and samples were decanted directly from the artesian discharge.

Three well volumes of water were removed from each well prior to sampling. Purge water was placed in a sealed 55 gallon drum and stored on site for future disposal.

The groundwater samples were collected, preserved and filtered as necessary, and placed in laboratory-cleaned sample bottles. Filtering was performed in the field using 0.45 micron disposable filter cartridges. The sample bottles were labeled identifying sample number, location, and date; placed on ice; and shipped in a cooler overnight to Enviroscan Corp. (WDNR certified analytical laboratory) in Rothschild, Wisconsin for analysis. SEH standard chain-of-custody procedures were followed regarding shipment and receipt of samples. Copies of the chain-of-custody records are included with the analytical results found in Appendix D, "Analytical Results".

7.3.1 Groundwater Analytical Results

The groundwater analytical results from Enviroscan are presented in Appendix D. A summary of historical (Northern Environmental) and current (SEH) groundwater analytical results is provided in Table 4, "Summary of Groundwater Analytical Results - Ashland Lakefront Property".

The groundwater samples collected by SEH were analyzed for the following parameters:

Parameter	Analytical Method
PAHs	U.S. EPA Method SW846-8310
VOCs	U.S. EPA Method SW846-8021
Cyanides	U.S. EPA Method 335.1, 335.3
Total Organic Carbon	APHA Method 505B
Arsenic	U.S. EPA Method 200.9
Aluminum	U.S. EPA Method 200.7
Iron	U.S. EPA Method 200.7

As reflected on Table 4, several parameters were detected in the groundwater samples collected from the property, including several VOCs, PAHs, metals, and indicator parameters. The concentrations of contaminants detected were compared to existing State of Wisconsin groundwater quality standards (ch. NR 140.10 and NR 140.12, Wis. Admin. Code). Enforcement Standards (ES) and/or Preventive Action Limits (PALs) were exceeded in one or more wells for benzene, ethylbenzene, toluene, xylenes, naphthalene, benzo-a-pyrene, and iron. No exceedances were recorded in the groundwater samples collected from the artesian well, indicating the vertical extent of contamination is limited to the shallow perched water table.

Horizontal extent of contamination has not yet been defined for the property. Based on the existing groundwater analytical data, the highest concentrations of VOCs and PAHs are located in the vicinity of MW-1 and MW-2. Elevated concentrations of VOCs were also detected in the groundwater sample collected by Northern Environmental from TP-2. Elevated concentrations of iron were detected in all three monitoring wells on the property.

8.0 Investigation Work Plan

Based on the results of the historical review, geophysical survey, previous site investigation, and groundwater monitoring, several environmental issues were identified requiring additional investigation. The issues identified include:

- Location marked as "Coal Tar Dump" on 1951 historical site map.
- Electromagnetic low conductivity anomalies on the south-southeast and north-northwest portions of the property.
- Deep magnetic anomaly located northeast of the existing WWTP.
- The presence of numerous small buried ferrous metal objects on the west side of the property, based on the magnetometer survey.

- The presence of elevated concentrations of VOCs, PAHs, and iron in site groundwater.
- The lack of definition of horizontal extent of contamination (including potential off-site contaminant migration and/or off-site source area(s)).
- Area of groundwater seepage exhibiting an apparent sheen observed on the south side of the property.

In order to address the areas of concern, SEH will perform additional field activities on the property. Activities will include: test pit excavation; soil boring drilling and sampling; monitoring well installation, development and sampling; and sampling of an existing seep. The proposed laboratory analyses will be performed using the following methods:

Parameter	Method	
	Soils	**Groundwater**
VOCs	EPA SW846-8021	EPA SW846-8021
PAHs	EPA SW846-8270	EPA SW846-8270
PCBs	EPA SW846-8080	N/A
Arsenic (As)	EPA Method 200.7	EPA Method 200.9
Cadmium (Cd)	EPA Method 200.7	EPA Method 200.9
Chromium (Cr)	EPA Method 200.7	EPA Method 200.9
Copper (Cu)	EPA Method 200.7	EPA Method 200.7
Lead (Pb)	EPA Method 200.7	EPA Method 200.9
Selenium (Se)	EPA Method 200.7	EPA Method 200.9
Zinc (Zn)	EPA Method 200.7	EPA Method 200.7
Iron (Fe)	EPA Method 200.7	EPA Method 200.7
TOC	N/A	APHA Method 505B
Cyanides	N/A	EPA SW846 335.1 and 335.3
Sulfate	N/A	E375.2

N/A = Not Applicable

The rationale for selecting this parameter list includes:

- Previously identified contaminants;
- Metals/inorganics occurring at a minimum of 25 percent of MGP sites (GRI document); and,
- Metals requiring analysis for landfills under NR 508 Wis. Admin. Code public health standards.

Proposed field activities will be conducted in accordance with standard SEH protocols found in Appendix E, "Standard Protocols". The tasks outlined in the following subsections will be performed during the next phase of the RI.

8.1 Task 1: Test Pit Excavation

A total of eight test pits will be excavated on the Ashland Lakefront Property in the approximate locations shown on Figure 7, "Proposed Test Pit/Temporary Well Locations". Test pits TP-1, TP-2, and TP-3 will be placed on the west side of the property in the proximity of the scattered small buried metal objects identified during the magnetometer survey. Test pit TP-4 will be placed in the area marked "Coal Tar Dump" on the 1951 historical site map (Appendix B). Test pits TP-5 and TP-6 will be placed on the south side of the property in the area of a low conductivity anomaly detected during the EM31 survey (TP-6 will also be placed in the approximate location of the former ravine outfall). Test pit TP-7 will be placed on the north side of the property in a low conductivity anomaly area. Test pit TP-8 will be excavated in the deep magnetic anomaly location identified during the magnetometer survey.

Test pit excavation will be performed with a backhoe under the direction of an SEH hydrogeologist. Excavated soils will be screened in the field for VOCs using a flame ionization detector (FID) and headspace methods. Soils in which VOCs are detected or which appear to be visibly impacted will be stockpiled separately from soils which do not appear to be impacted (either based on FID readings or on visual observations). Test pits will be excavated to below the water table at each location. During excavation backfilling, impacted soils will be placed at the bottom of the excavation and covered with the non-impacted soils. Soil lithology and field observations will be recorded on test pit logs.

One or two soil sample(s) will be collected from each test pit for laboratory analysis. Soil samples collected from the buried metal area (TP-1, TP-2, and TP-3) will be analyzed for VOCs, PAHs, PCBs (select samples), and select heavy metals (Cd, Pb, Se). Soil samples collected from the remaining test pits will be analyzed for VOCs and PAHs and select heavy metals.

8.2 Task 2: Soil Borings/Temporary Monitoring Wells

A total of twelve additional soil borings will be drilled on the Ashland Lakefront property. The borings will be placed to define lateral extent of soil and groundwater impacts on the property and to identify potential soil and groundwater impacts in portions of the property not previously investigated. The proposed locations of the soil borings are shown on Figure 7.

Soil borings will be performed using a truck-mounted rotary drill rig and hollow-stem augers under the direction of an SEH hydrogeologist. Soil samples will be collected at 2.5 foot intervals from 1 foot below ground surface until natural cohesive soils are reached. Soil samples will be collected using Standard Penetration Test methods (ASTM D1586). As samples are collected, a portion of each sample will be headspace field screened for VOC concentration using a FID. The remainder of each sample will be preserved for potential analysis. Lithologic descriptions as well as field observations will be recorded by SEH on soil boring logs (WDNR Form 4400-122).

One to two soil sample(s) from each boring will be selected for laboratory analysis. The sample(s) selected will be from the soil unit(s) most impacted by contaminants based on FID headspace readings and/or visual observations. If contamination is not apparent, a soil sample from just below the shallow groundwater surface will be selected for analysis. Additional soil samples may be selected for analysis if warranted by field observations.

The samples selected for analysis from the soil borings will be analyzed for VOCs, PAHs, and select heavy metals.

Upon completion of drilling, each boring will be instrumented as a temporary monitoring well. The temporary wells will be installed in general accordance with ch. NR 141, Wis. Admin. Code with the exception that protective permanent steel casings will not be installed. Well screens will be positioned to intersect the shallow groundwater surface, and screen lengths of up to 15 feet selected to allow the entire fill interval and underlying granular soil interval to be sampled. This will allow for collection of both low and high density contaminants. A locking cap will be installed on the top of the PVC well casing to minimize the possibility of vandalism to the temporary wells. Well construction details (WDNR Form 4400-113A) will be completed by SEH for each well installed.

8.3 Task 3: Well Development and Sampling

Upon completion of well installation, the temporary wells will be developed in accordance with ch. NR 141, Wis. Admin. Code. Water will be removed from each well until a minimum of ten well volumes have been removed or until further yield cannot be obtained. Development water will either be characterized and disposed to the City of Ashland sanitary sewer system after obtaining necessary permits, or containerized for future disposal.

After development, the wells will be allowed to stabilize for a minimum of 24 hours prior to sampling. One round of groundwater samples will then be collected from twelve temporary wells, three existing wells, as well as two existing artesian wells in the proximity of the property. The wells will be sampled with new disposable polyethylene bailers and nylon string. A minimum of three well casing volumes of water will be removed from each well (except the artesian wells) prior to sampling. The samples will then be collected, preserved and filtered as necessary, and placed in the appropriate sample bottles using a polyethylene bottom-emptying device. Groundwater samples will be analyzed for PAHs, VOCs, total organic carbon (TOC), and select heavy metals (if MGP or landfill wastes are encountered).

8.4 Task 4: Groundwater Seep Sampling

Groundwater samples will be collected from the seep observed on the southern portion of the site. The samples will be collected directly from the seep, preserved and filtered as necessary, and placed in the appropriate sample bottles. The groundwater seep samples will be analyzed for VOCs and PAHs.

8.5 Task 5: Permanent Well Installation and Sampling

Upon review of the groundwater analytical data from the first round of sampling, four of the temporary wells will be selected for conversion to permanent groundwater monitoring wells. The well selection will be based on which wells will be most beneficial for long-term monitoring of the site before and during remediation (if necessary). Wells selected for conversion will be fitted with locking steel protective casing. Three bumper posts will also be installed around each converted well.

The temporary wells not selected for conversion to permanent wells will be abandoned in accordance with ch. NR 141, Wis. Admin. Code. The well casings and screens will be removed and the well seals and sand packs drilled out and the resultant cuttings containerized for future disposal. The open boreholes will then be filled with chipped bentonite. Borehole abandonment forms (WDNR Form 3300-5B) will be completed by SEH for each abandoned well.

One additional round of groundwater samples will be collected from the permanent monitoring wells on the property. The samples will be collected as previously described and analyzed for VOCs, PAHs, TOC, heavy metals, cyanides, sulfates, and iron. Additional parameters may be selected based on the results of the first round of analysis.

8.6 Task 6: Shallow Aquifer Characterization

A minimum of three rounds of groundwater elevations will be recorded in the site monitoring wells in order to determine hydraulic gradients and direction of shallow groundwater flow. Two rounds of elevations will include both the temporary and permanent wells, while the third round of elevations will include the permanent wells only. Water level measurements will be recorded using an electric water level indicator. If free-phase liquids are observed floating on the groundwater surface, their thickness will be measured using an oil-water interface probe.

Field hydraulic conductivity tests will be performed on the three existing wells and the four new permanent wells. The tests will be performed by instantaneously lowering the head of water in the well using either a bailer or an electric pump. The rate of recharge will then be recorded using either an electronic downhole datalogger or an electric water level indicator (the instrument selected will depend on the rate of recharge). The hydraulic conductivity values for each well will then be computed using the AQTESOLV® computer program. Hydraulic conductivity results will be used during remedial design for the property.

8.7 Task 7: Residuals Management

As stated in the previous tasks, residuals generated during site investigation activities will be managed and disposed as necessary. Excavated soils generated during test pit excavation will be segregated into contaminated piles and apparently non-contaminated piles. Upon completion of excavation, contaminated soils will be placed at the bottom of the test pit and covered with apparently non-contaminated soils. Soils generated during drilling of soil borings will be placed in sealed 55 gallon drums. These soils will be appropriately disposed after soil analytical results are reviewed. Groundwater generated during development and purging of monitoring wells may be disposed to the City of Ashland sanitary sewer system if permitting can be obtained. If permits are not obtained, groundwater will be containerized for future disposal pending review of groundwater analytical results. Disposable equipment (i.e., bailers, personal protective equipment) will be placed in plastic waste bags and disposed as non-hazardous solid waste.

8.8 Task 8: Existing Conditions Report:

SEH will prepare an Existing Conditions Report summarizing the procedures and results of activities performed on the project. The report will consist of a narrative section, plan sheets, figures, tables, and appendices. Six copies of the report will be submitted to the WDNR.

The narrative section of the report will summarize historical information as it relates to the likely sources of contamination. The procedures for the field and laboratory activities will also be briefly discussed. A majority of the narrative section of the report will focus on the results of the investigation, the interpretation of the results, and the need for additional investigative or remedial efforts.

The results of the investigation will be described in the narrative section and summarized in tabular form. The complete analytical reports will be provided in the appendices of the report. Sample locations and site features will be presented on a site conditions base map. The base map will show the site topography, boundaries, utilities, man-made features, surface water bodies, monitoring wells, and other pertinent information.

A minimum of two geologic cross-sections will be prepared passing through select soil borings which illustrate existing topography, soil borings, soil classification and other properties, interpreted soil stratigraphy, monitoring wells, stabilized water level readings and environmental data.

A water table map with a maximum one foot contour intervals based on stabilized water level readings will also be prepared using the site plan. A separate plan sheet based on the information obtained from the geophysical investigation will also be included in the Existing Condition Report.

A discussion regarding the interpretation of the results including comparison of contaminant levels to existing environmental criteria and standards will be presented in the narrative and table sections of the report. A discussion of the potential for further environmental impact as indicated by the results will be included. The nature and mobility of the contaminants will be addressed taking into consideration the contaminant's density, viscosity, potential reaction products and sorption properties, as well as its dispersive flow characteristics.

The Existing Conditions Report will ultimately be used in conjunction with a treatability study of the site to prepare a site remedial action plan. The remedial action plan will include conceptual design details for the selected remedies including flow/process diagrams, site plan and drawings. The conceptual designs will be suitable for development of estimate construction/remediation costs. Upon approval of the remedial action plan by the WDNR, the final design plan and specification for the proposed remedial efforts can be developed.

9.0 Documentation and Quality Assurance/Quality Control (QA/QC)

Specific documentation and QA/QC procedures will be followed during the investigative activities at the Ashland Lakefront Property to ensure that accurate and representative data is collected. This section describes the procedures to be followed during field activities only. The laboratory QA/QC procedures will be performed in accordance with specific method requirements and laboratory standard operating procedures. Enviroscan Corp. of Rothschild, Wisconsin has been selected to perform the laboratory analysis for the Ashland Lakefront Property project. Enviroscan Corp. is a Wisconsin certified laboratory (Lab No. 737053130) and has been audited by the U.S. EPA for work under the Resource Conservation and Recovery Act (RCRA). The following section outlines the field documentation and QA/QC procedures.

9.1 Field Documentation

A written and photographic log will be used to document field procedures and conditions. The written log will be kept in a bound field book with pre-numbered pages. Field notes will be entered with an indelible ink pen at the time information is obtained. Field notes will be entered daily when activities occur. The field notes will include at least the following information:

- Date
- Field personnel (including owner, consultants, subcontractors, regulatory agency)
- Weather (temperature, cloud cover, wind, precipitation)
- Equipment (including screening, sampling, subcontractor equipment)
- Calibrations performed, calibration curves or standards
- Results and techniques used for field screening
- Sampling locations (this requires an accurate map)

- Methods and/or devices used in sampling.
- Decontamination procedures used.
- Time and date of sample collection.
- Type of sample (soil, groundwater, surface water, etc.)
- Field preservation performed
- Field QC data associated with the sample
- Sample ID (must clearly correlate to sample locations shown on a map)
- Any deviations from work plan, SOP or special conditions

In addition to the written log, a photographic log will also be prepared documenting pertinent field conditions and sampling procedures. The photographs will be labeled to indicate the subject, date, time, direction and other relevant information. Upon completion of the field activities, the photographs will be assembled in a photograph album and placed in the project file.

9.2 QA/QC

For this project, quality assurance is the overall program for assuring reliability of field and analytical data. Quality control is the routine application of procedures for obtaining prescribed standards of performance during the field activities.

All sampling equipment will be stainless steel and decontaminated prior to use in the field, or disposable and dedicated to a single sample. When field equipment will be reused in the field (i.e., collect samples at different depths or locations), the non-disposable equipment will be decontaminated prior to reuse. The decontamination method involves a detergent or trisodium phosphate (TSP) wash, and a triple rinse with deionized water. The sampling equipment for the project will include a stainless steel split spoon, stainless steel or disposable bailers, and stainless steel spatulas. Sample collection will begin at the point of assumed least contamination and continue toward the areas of potential higher contamination. Samples will be transferred directly into laboratory clean glass bottles with Teflon caps.

Individual labels describing the sample, number, location, sampler's name, date, preservatives, and other relevant information will be attached to the bottles upon collection. All samples will be tracked using strict chain-of-custody procedures. Sample bottles will be tracked from the laboratory, to the field and back to the analytical laboratory. The chain-of-custody will also document relevant sampling and preservation.

Field instruments will be calibrated according to the manufacturers recommendations. FIDs will be calibrated with the appropriate calibration gas. The instruments will be calibrated with the following frequency:

1. At the beginning of each day.
2. After any significant changes in humidity or temperature (more than 15 degrees Fahrenheit).
3. After any repairs to the instrument are performed.

Field QA samples will include the following:

- Duplicate samples are discrete samples obtained from the same location and time. These samples are generally formed by splitting a larger sample into two subsamples.
- Temperature blanks are additional water samples collected in the same manner as samples, used to determine the temperature of samples on receipt by the lab.
- Field blanks are water samples processed through the same sampling and filtering equipment, used as a check on decontamination procedures (not collected when sampling with disposable bailers).
- Trip blanks are reagent water samples analyzed before leaving the lab and on their return as a check on contamination from sources outside samples (unless otherwise specified).

A minimum of 5 percent of the soil samples collected will be duplicated for submittal to the laboratory. A minimum of one temperature, field and trip blank will be submitted to the laboratory per day that sampling occurs for each matrix. Field and trip blanks will be analyzed for VOCs.

Field QA samples will be handled and stored in an identical manner as actual samples. Results of the analysis of duplicates, temperature, field, and trip blanks will be included in the Existing Conditions Report, and will be taken into account in the data assessment portion of the report.

Tables

Table 1
Summary of Groundwater Elevation Data

	MW-1	MW-2	MW-3
Top of Casing Elevation (MSL)	608.32	608.22	612.10
Land Surface Elevation (MSL)	605.30	605.57	609.47
Date	Depth to Groundwater Below Top of Casing (Feet)		
6/28/94	8.59	6.89	10.80
Date	Groundwater Elevation (MSL)		
6/28/94	599.73	601.33	601.30

1. All elevations recorded in Mean Sea Level (MSL) datum.
2. All depth measurements in feet.

Table 2
Major Components in Creosote

Peak No.	Component	Whole Creosote (Approx. %)	Boiling Point[1] (°C)
1	Naphthalene	3.0	218
2	2-Methylnaphthalene	1.2	241.05
3	1-Methylnaphthalene	0.9	244.64
4	Biphenyl	0.8	255.9
5	Dimethylnaphthalenes	2.0	268
6	Acenaphthene	9.0	279
7	Dibenzofuran	5.0	287
8	Fluorene	10.0	293-295
9	Methylfluorenes	3.0	318
10	Phenanthrene	21.0	340
11	Anthracene	2.0	340
12	Carbazole	2.0	355
13	Methylphenanthrenes	3.0	354-355
14	Methylanthracenes	4.0	360
15	Fluoranthene	10.0	382
16	Pyrene	8.5	393
17	Benzofluorenes	2.0	413
18	Chrysene	3.0	448

[1] Values from Handbook of Chemistry and Physics, 1971-72, 52nd ed., Chemical Rubber Publishing Co., Cleveland, Ohio.
Source: Management of Manufactured Gas Plant Sites, Gas Research Institute document GRI-87/0260.1.

Table 3
Wastes and Chemicals of Interest at MGP Sites

WASTES				
Free tars, oils, and lampblack	Organic-contaminated soils - Heavily contaminated - Lightly contaminated	Organic-contaminated vessel, surface, and groundwaters	Purifier wastes	Mixed wastes and fill

CHEMICALS				
Inorganics	Metals	Volatile Aromatics	Phenolics	Polynuclear Aromatic Hydrocarbons
Ammonia	Aluminum	Benzene	Phenol	Acenaphthene
Cyanide	Antimony	Ethyl Benzene	2-Methylphenol	Acenaphthylene
Nitrate	Arsenic	Toluene	4-Methylphenol	Anthracene
Sulfate	Barium	Total Xylenes	2,4-Dimethylphenol	Benzo(a)anthracene
Sulfide	Cadmium			Benzo(a)pyrene
Thiocyanates	Chromium			Benzo(b)fluoranthene
	Copper			Benzo(g,h,i)perylene
	Iron			Benzo(k)fluoranthene
	Lead			Chrysene
	Manganese			Dibenzo(a,h)anthracene
	Mercury			Dibenzofuran
	Nickel			Fluoranthene
	Selenium			Fluorene
	Silver			Naphthalene
	Vanadium			Phenanthrene
	Zinc			Pyrene
				2-Methylnaphthalene

Source: Management of Manufactured Gas Plant Sites, Gas Research Institute document GRI-87/0260.1.

Table 4
Summary of Groundwater Analytical Results – Ashland Lakefront Property

Parameter	Concentrations in micrograms per liter (µg/l)											
	MW-1 1/25/89	MW-1 6/28/94	MW-2 1/25/89	MW-2 6/28/94	MW-3 1/25/89	MW-3 6/28/94	MW-3 Duplicate 6/28/94	AW-1 1/25/89	AW-1 6/28/94	TP-2 8/28/91	PAL	ES
VOCs												
Benzene	190	4,240	390	1,090	51.4	0.8	0.8	N/D	N/D	2,000	0.5	5
Ethylbenzene	N/D	413	190	113	N/D	N/D	N/D	N/D	N/D	240	140	700
Naphthalene	N/A	1,490	N/A	607	N/A	N/D	N/D	N/A	N/D	150	8	40
Toluene	27.1	651	31.7	N/D	N/D	N/D	N/D	N/D	N/D	N/D	68.6	343
1,2,4-Trimethylbenzene	N/A	107	N/A	N/D	N/A	N/D	N/D	N/A	N/D	170	--	--
Xylenes	223.8	449	350	N/D	N/D	N/D	N/D	N/D	N/D	290	124	620
PAHs												
Acenaphthene	330	253	300	42.8	88	11.9	N/A	N/D	N/D	N/A	--	--
Acenaphthylene	38	465	33	98.5	N/D	N/D	N/A	N/D	N/D	N/A	--	--
Anthracene	110	9.35	320	1.60	100	39.0	N/A	N/D	N/D	N/A	--	--
Benzo(a)Anthracene	59	0.473	93	0.522	180	56.4	N/A	N/D	N/D	N/A	--	--
Benzo(a)Pyrene	51	0.539	79	0.691	170	69.3	N/A	N/D	N/D	N/A	0.0003	0.003
Benzo(b)Fluoranthene	53	N/D	77	0.387	150	28.1	N/A	N/D	N/D	N/A	--	--
Benzo(ghi) Perylene	27	N/D	45	N/D	110	N/D	N/A	N/D	N/D	N/A	--	--
Benzo(k)Fluoranthene	N/D	N/D	N/D	N/D	N/D	19.8	N/A	N/D	N/D	N/A	--	--
bis(2-Ethylhexyl)Phthalate	18	N/A	28	N/A	58	N/A	N/A	N/D	N/A	N/A	--	--
Chrysene	60	N/D	92	N/D	180	N/D	N/A	N/D	N/D	N/A	--	--
Dibenzo(a,h)Anthracene	N/D	N/D	14	N/D	26	N/D	N/A	N/D	N/D	N/A	--	--
Di-n-Butylphthalate	N/D	N/A	N/D	N/A	N/D	N/A	N/A	4	N/A	N/A	--	--
Fluoranthene	110	N/D	140	N/D	260	210	N/A	N/D	N/D	N/A	--	--

N/D = Analyte not detected above laboratory quantitation limit
N/A = Sample not analyzed for indicated parameter
BOD = Biological Oxygen Demand
COD = Chemical Oxygen Demand
TOC = Total Organic Carbon
PAL = Preventive Action Limit (ch. NR 140, Wis. Adm. Code)
ES = Enforcement Standard (ch. NR 140, Wis. Adm. Code)

Table 4
Summary of Groundwater Analytical Results – Ashland Lakefront Property (Continued)

Parameter	Concentrations in micrograms per liter (µg/l)											
	MW-1 1/25/89	MW-1 6/28/94	MW-2 1/25/89	MW-2 6/28/94	MW-3 1/25/89	MW-3 6/28/94	MW-3 Duplicate 6/28/94	AW-1 1/25/89	AW-1 6/28/94	TP-2 8/28/91	PAL	ES
Fluorene	180	51.3	150	4.05	83	6.29	N/A	N/D	N/D	N/A	--	--
Indeno(1,2,3-cd)Pyrene	22	N/D	33	N/D	80	N/D	N/A	N/D	N/D	N/A	--	--
1-Methyl Naphthalene	N/A	575	N/A	59.2	N/A	N/D	N/A	N/A	N/D	N/A	--	--
2-Methyl Naphthalene	N/A	344	N/A	20.1	N/A	N/D	N/A	N/A	N/D	N/A	--	--
Naphthalene	150	702	1,800	90.1	16	N/D	N/A	N/D	N/D	N/A	8	40
Phenanthrene	370	53.2	300	N/D	170	19.2	N/A	N/D	N/D	N/A	--	--
Phenol	N/D	N/A	14	N/A	N/D	N/A	N/A	N/D	N/A	N/A	1,200	6,000
Pyrene	230	N/D	370	N/D	790	317	N/A	N/D	N/D	N/A	--	--
Metals												
Aluminum	N/A	66	N/A	66	N/A	37	N/A	N/A	61	N/A	--	--
Arsenic	N/D	N/D	N/D	1.4	N/D	N/D	N/A	N/D	2.1	N/A	5	50
Chromium	N/D	N/A	N/D	N/A	N/D	N/A	N/A	N/D	N/A	N/A	10	100
Copper	23	N/A	N/D	N/A	N/D	N/A	N/A	N/D	N/A	N/A	130	1,300
Iron	N/A	1,210	N/A	3,650	N/A	959	N/A	N/A	N/D	N/A	150	300
Zinc	12	N/A	4	N/A	16	N/A	N/A	8	N/A	N/A	2,500	5,000
Indicators												
BOD (mg/l)	14	N/A	14	N/A	42	N/A	N/A	N/A	N/A	N/A	--	--
Chloride (mg/l)	54.8	N/A	64.6	N/A	64.1	N/A	N/A	N/A	N/A	N/A	125	250
COD (mg/l)	330	N/A	224	N/A	1,870	N/A	N/A	N/A	N/A	1,200	--	--
Sulfate (mg/l)	3.6	N/A	5.5	N/A	4.6	N/A	N/A	N/A	N/A	N/A	--	--
TOC (mg/l)	29.0	8.28	25.2	10.2	27.1	12.3	N/A	N/A	N/D	N/A	--	--

N/D = Analyte not detected above laboratory quantitation limit
N/A = Sample not analyzed for indicated parameter
BOD = Biological Oxygen Demand
COD = Chemical Oxygen Demand
TOC = Total Organic Carbon
PAL = Preventive Action Limit (ch. NR 140, Wis. Adm. Code)
ES = Enforcement Standard (ch. NR 140, Wis. Adm. Code)

Figures

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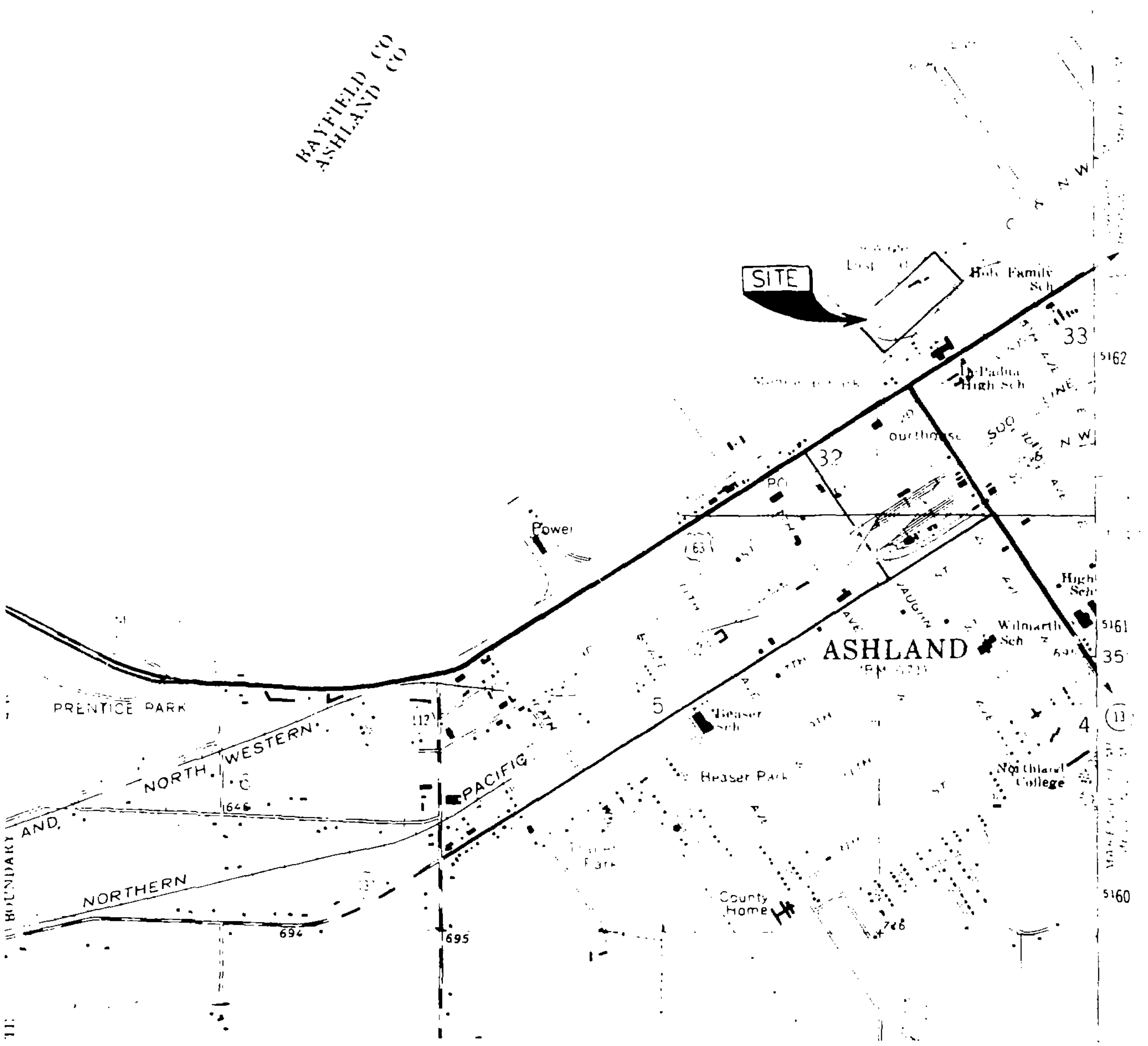
USGS ASHLAND WEST QUADRANGLE

WISCONSIN - ASHLAND CO. 7.5 MINUTE SERIES

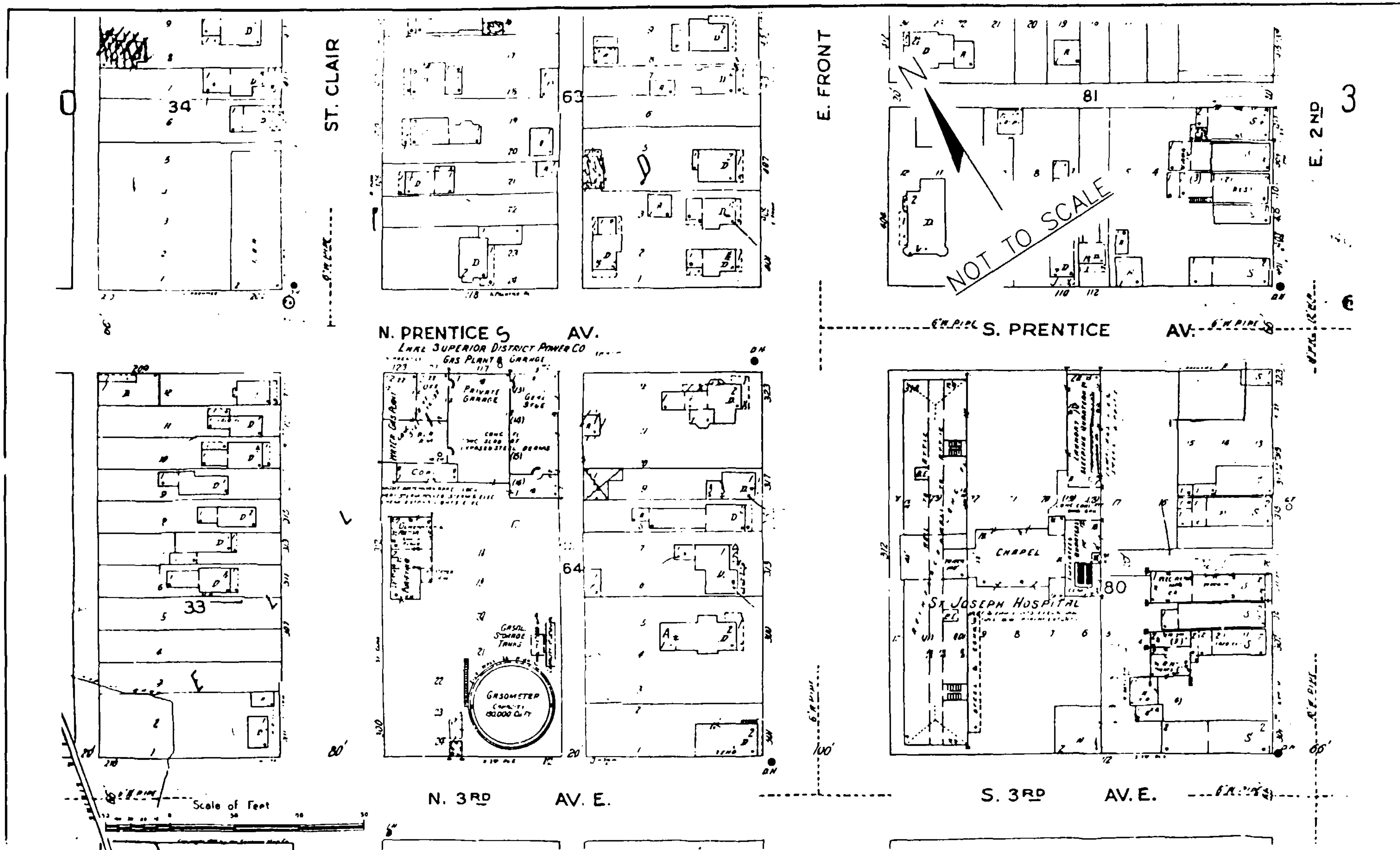
N

SCALE: 1"= 2,000'



DRAWN BY: CPE 08/05/94	ASHLAND LAKEFRONT PROPERTY	FILE NO. ASHLA9401
CHECKED BY: JG 08/05/94	FIGURE 1 SITE LOCATION	DRG. NO. 9401FUA1

SEH
ENGINEERS ■ ARCHITECTS ■ PLANNERS



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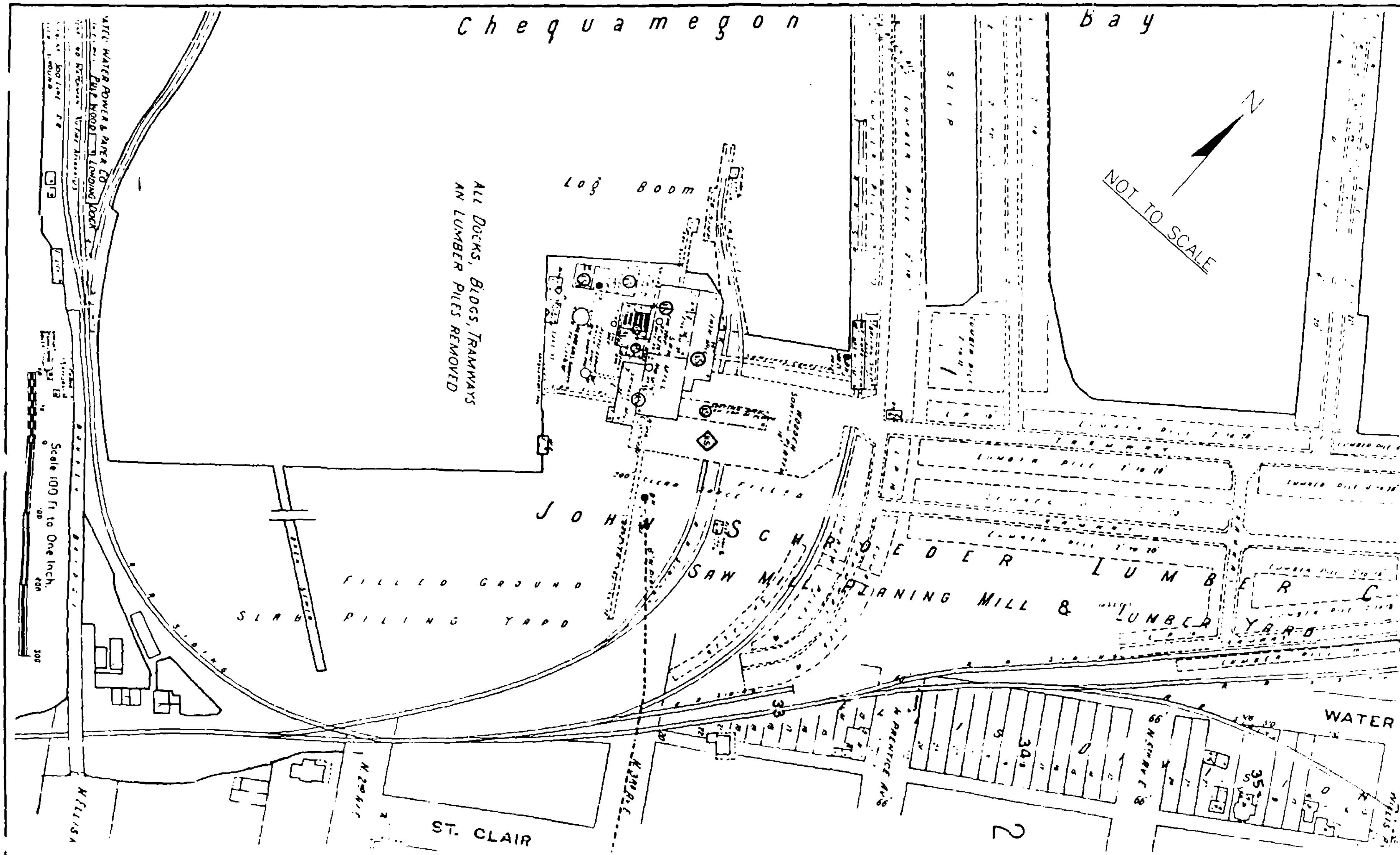

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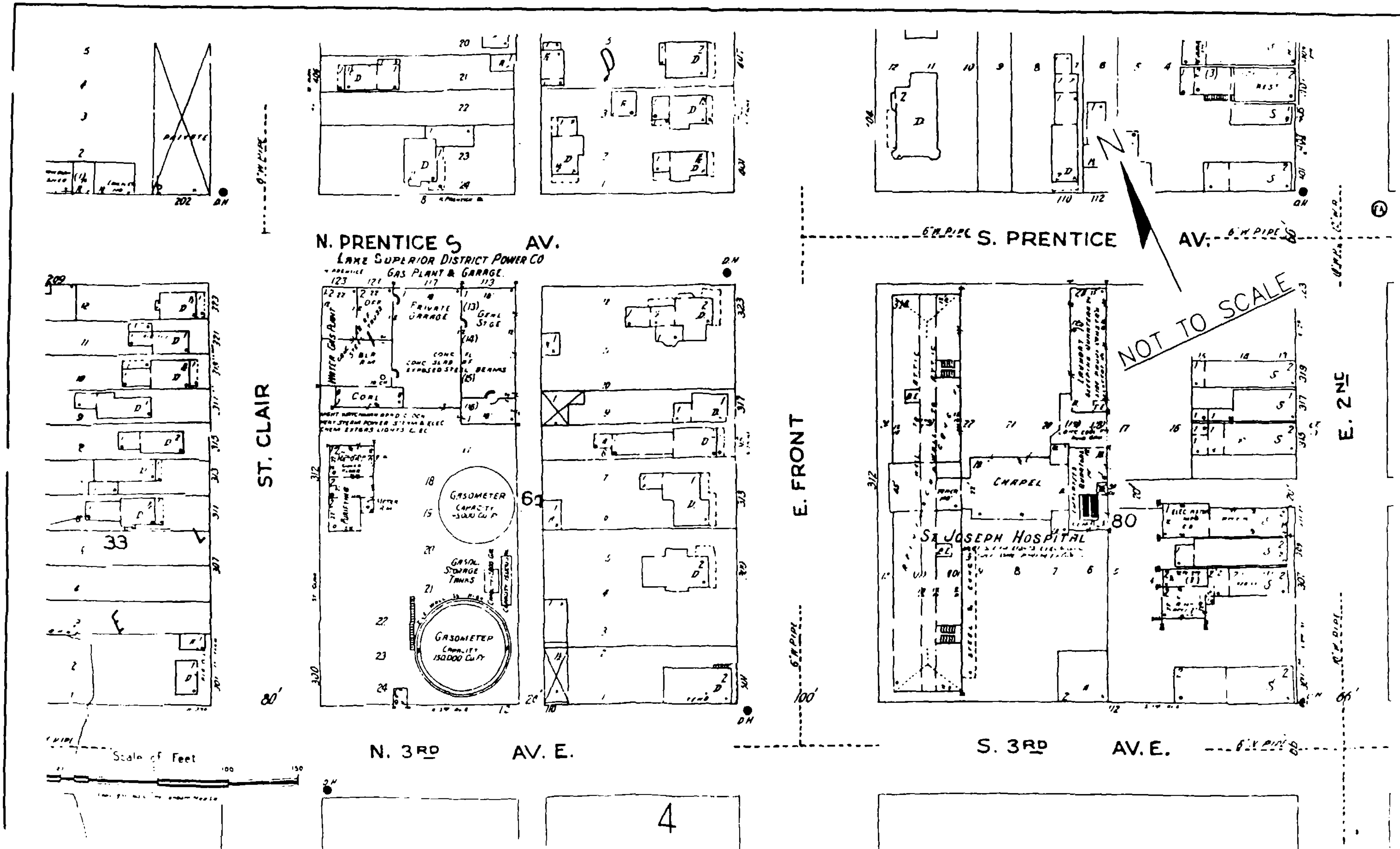

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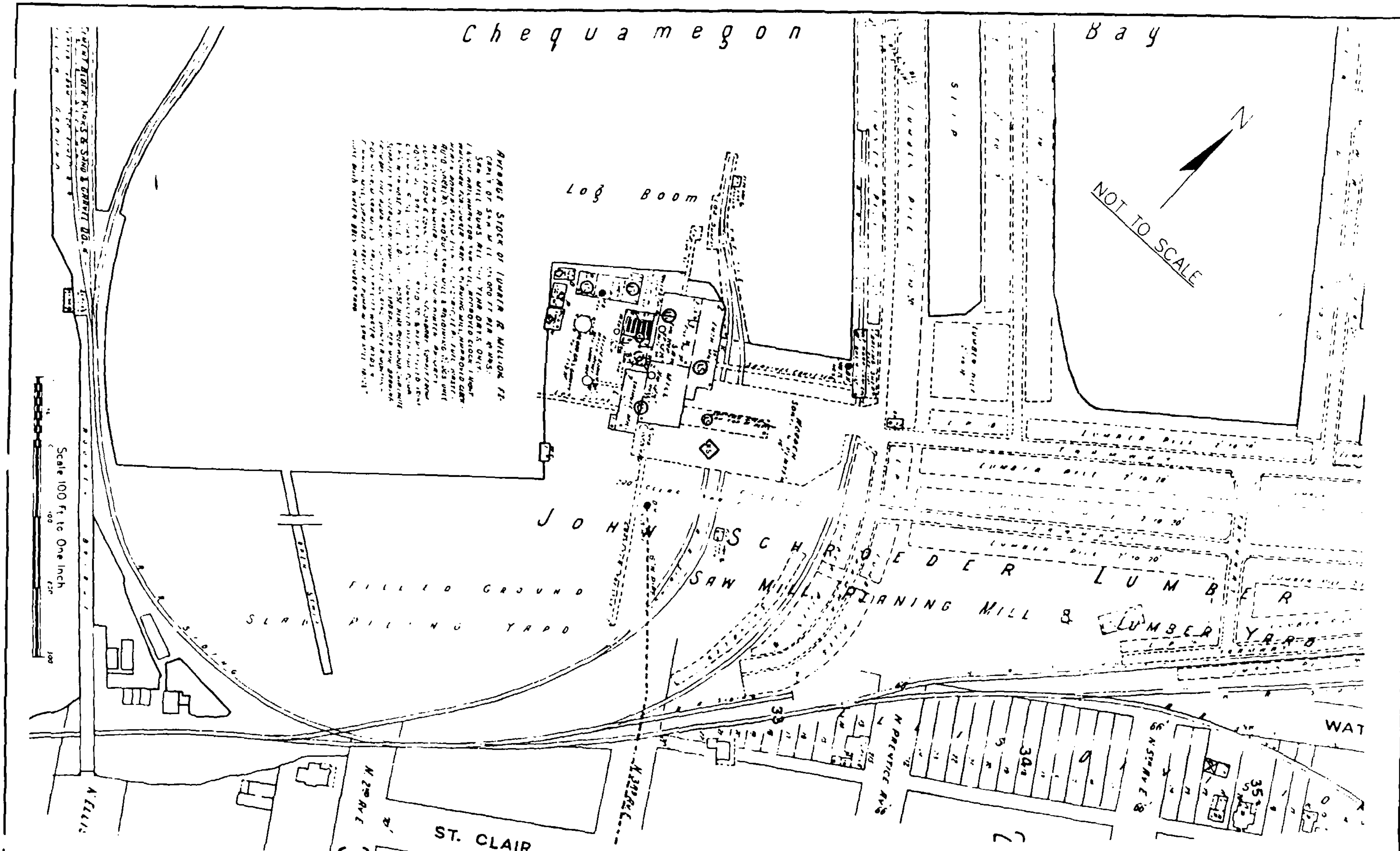

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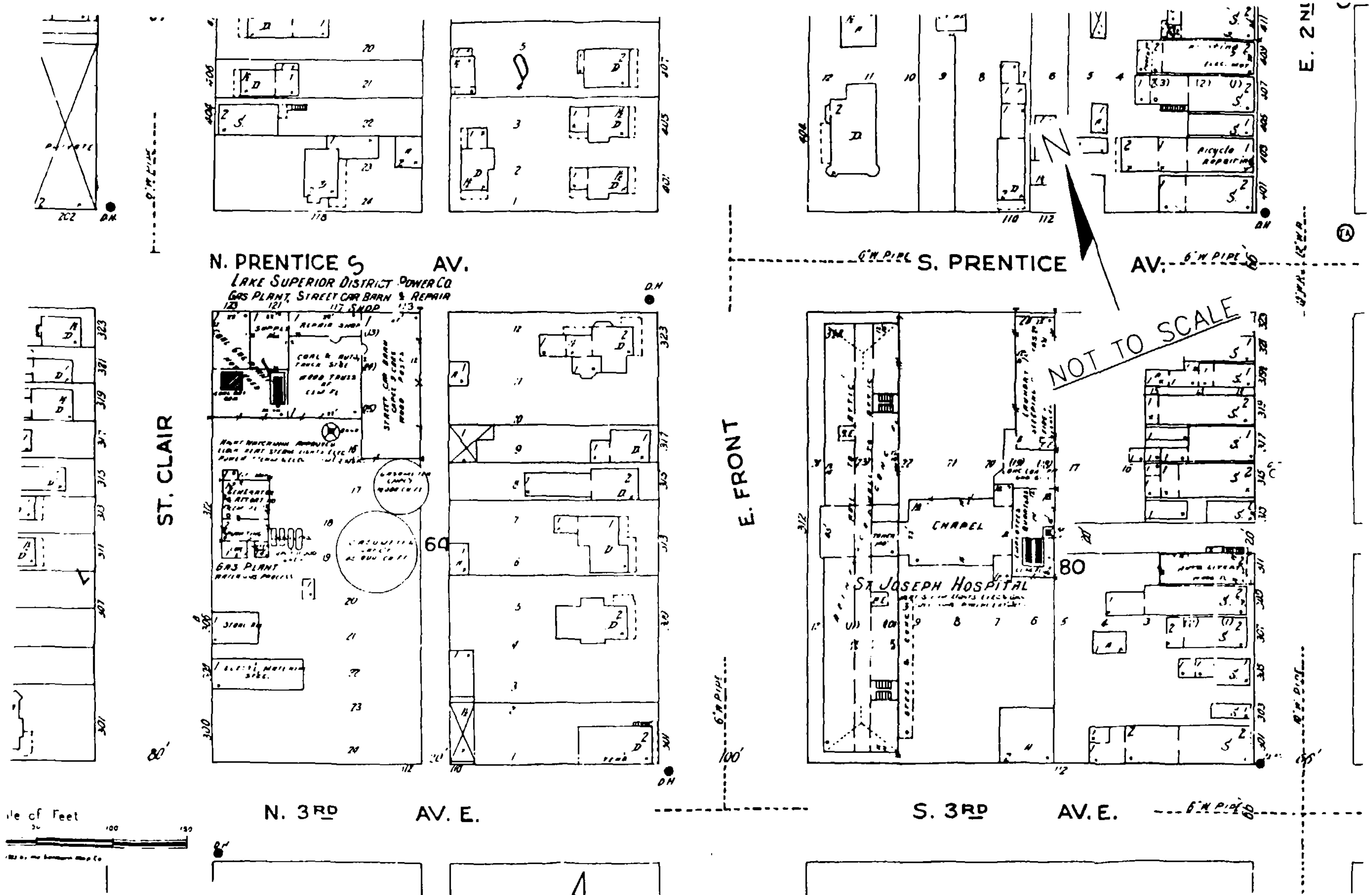
DATE 9401FZE1

CITY OF ASHLAND - SANBORN MAPS

1923
LOWER FILL AREA



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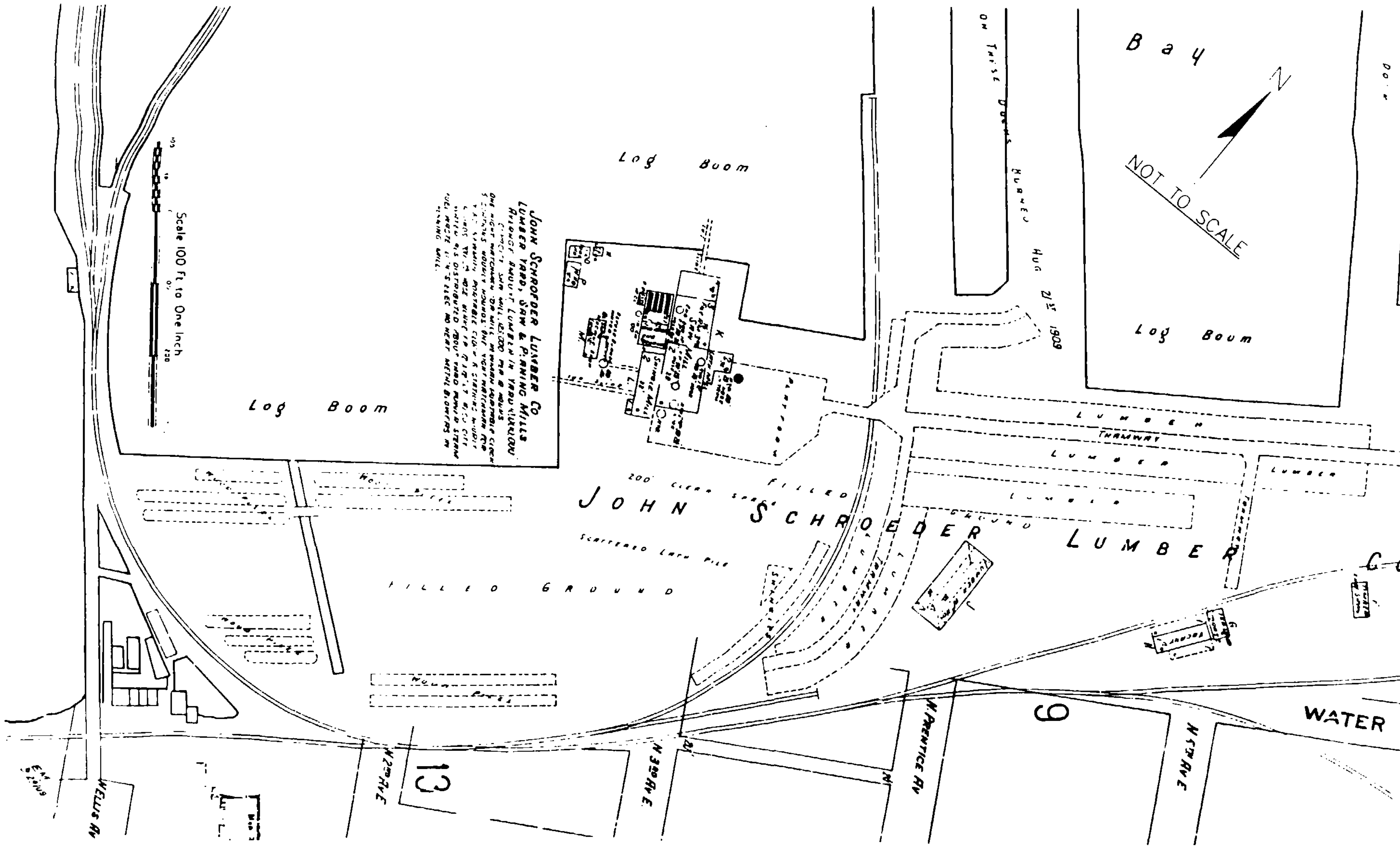
DATE 9401FZE1

CITY OF ASHLAND – SANBORN MAPS

1923

RIDGE TOP



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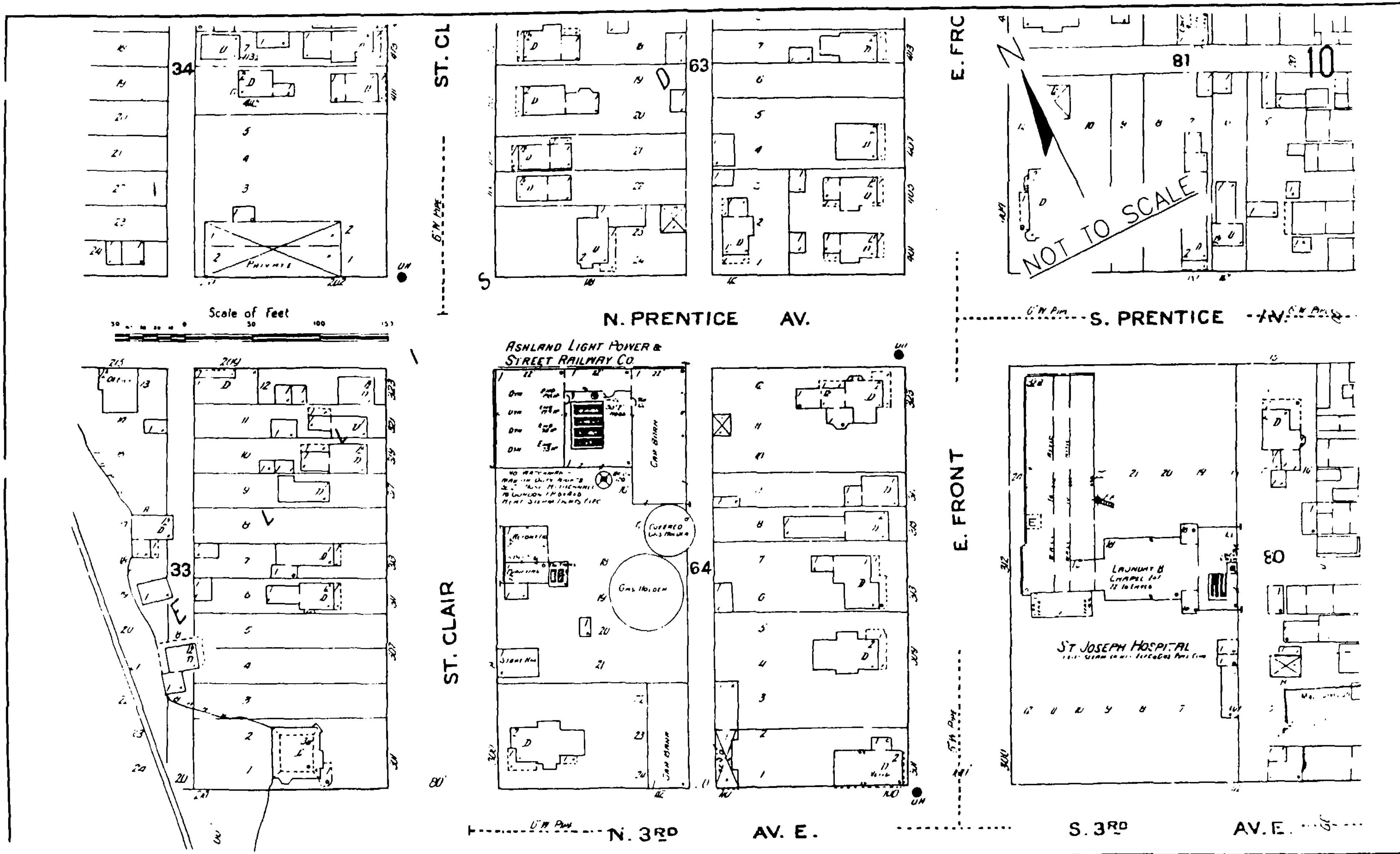

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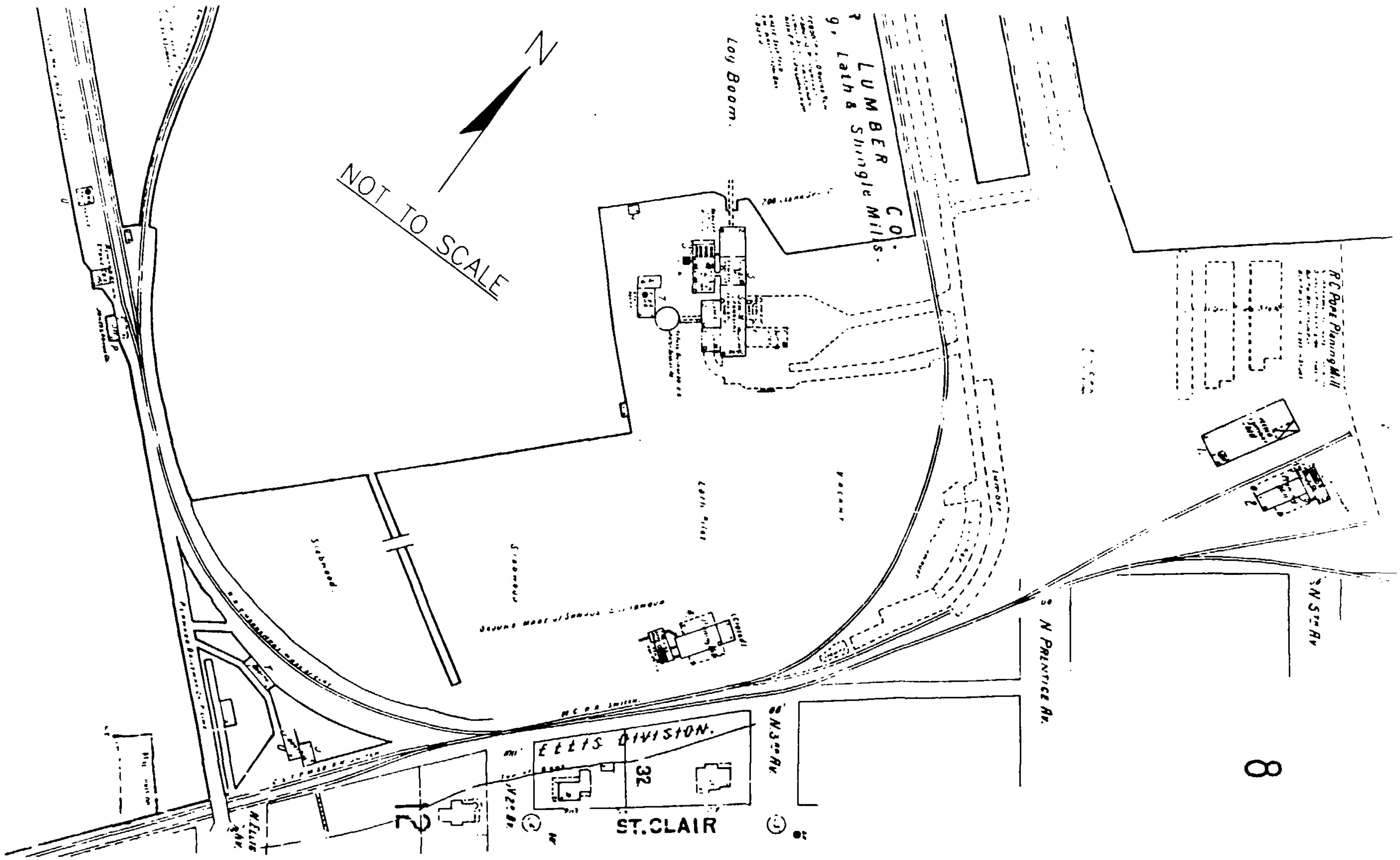

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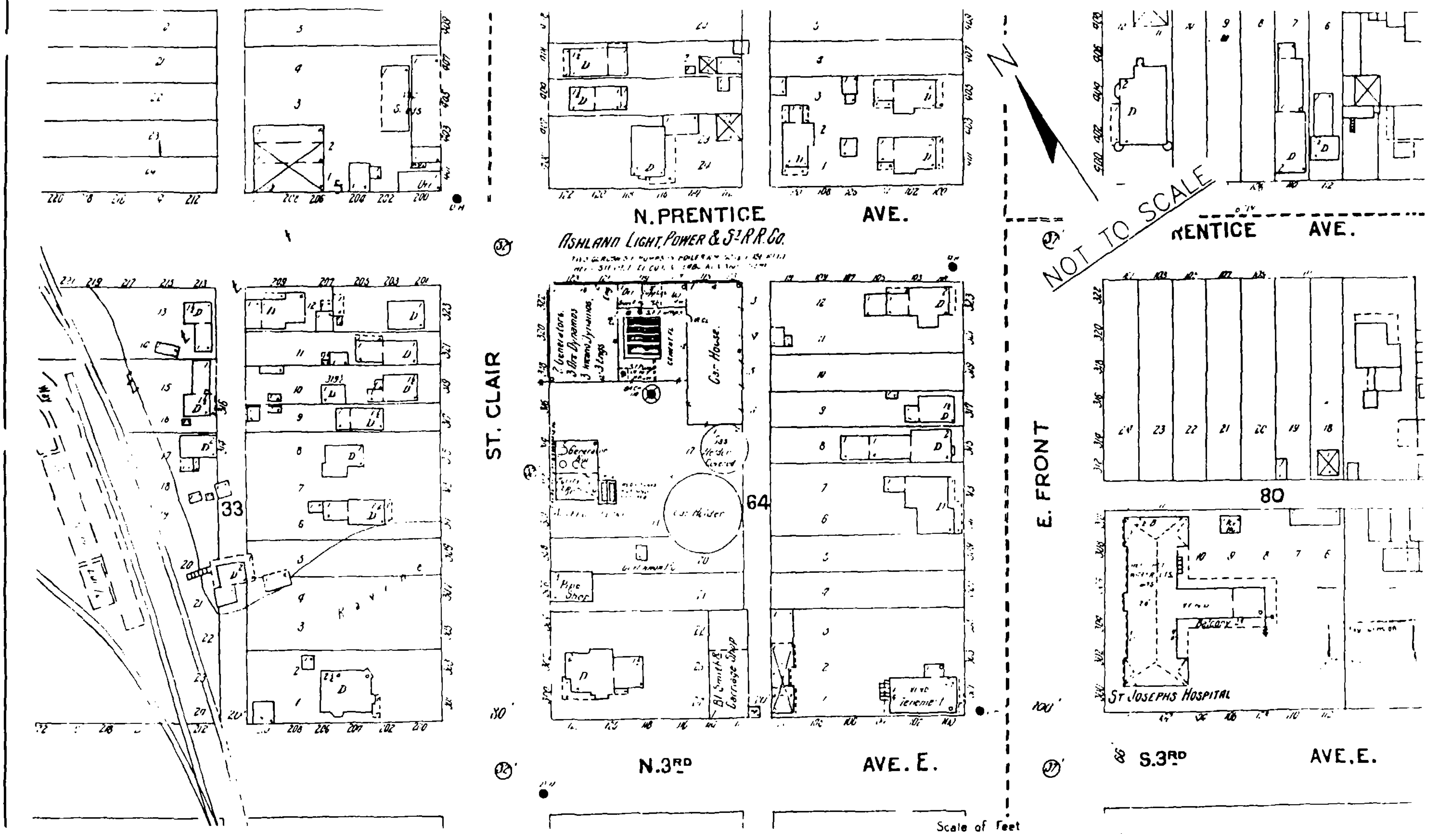
DATE 9401FZE1

CITY OF ASHLAND – SANBORN MAPS

1901

LOWER FILL AREA



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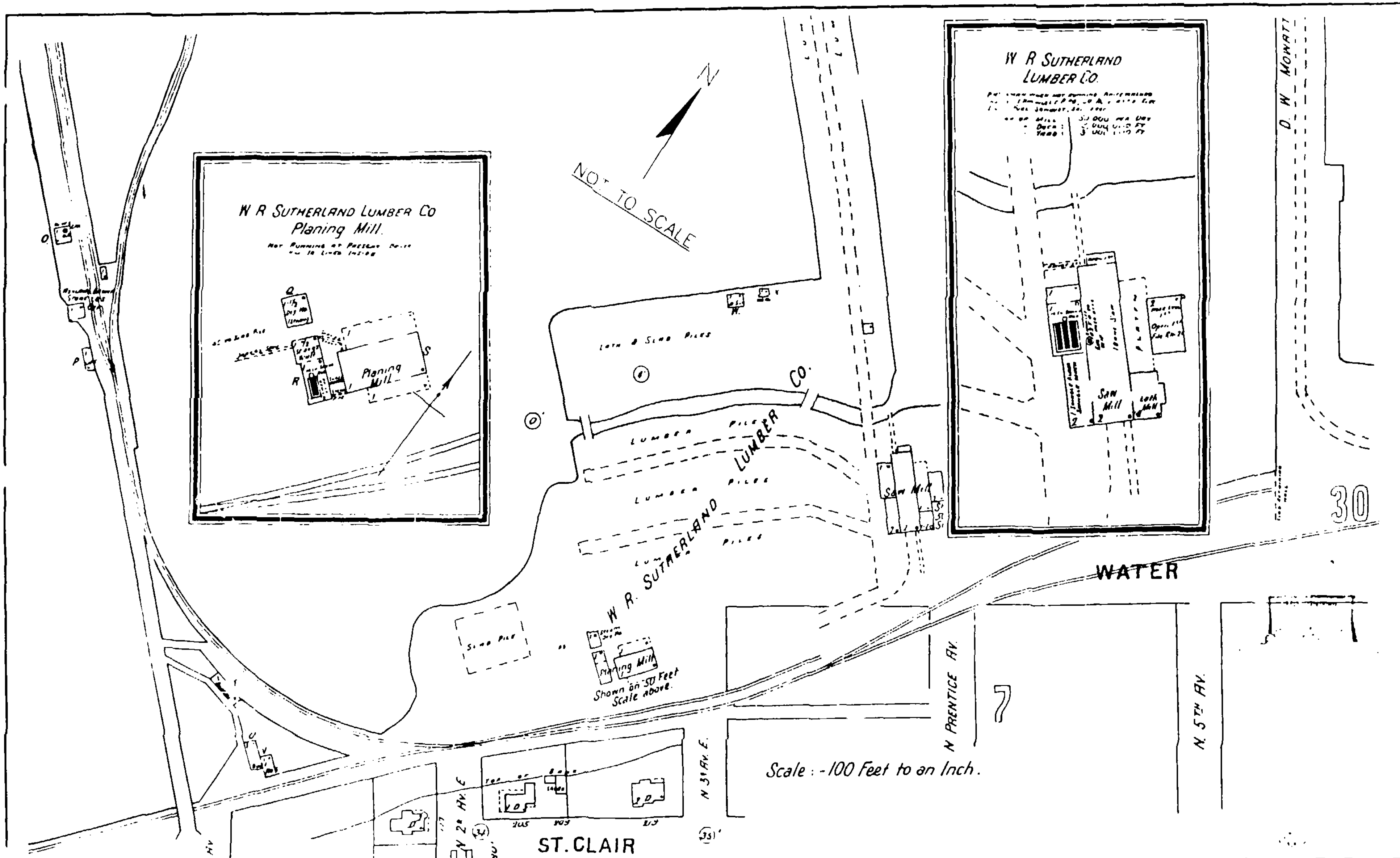

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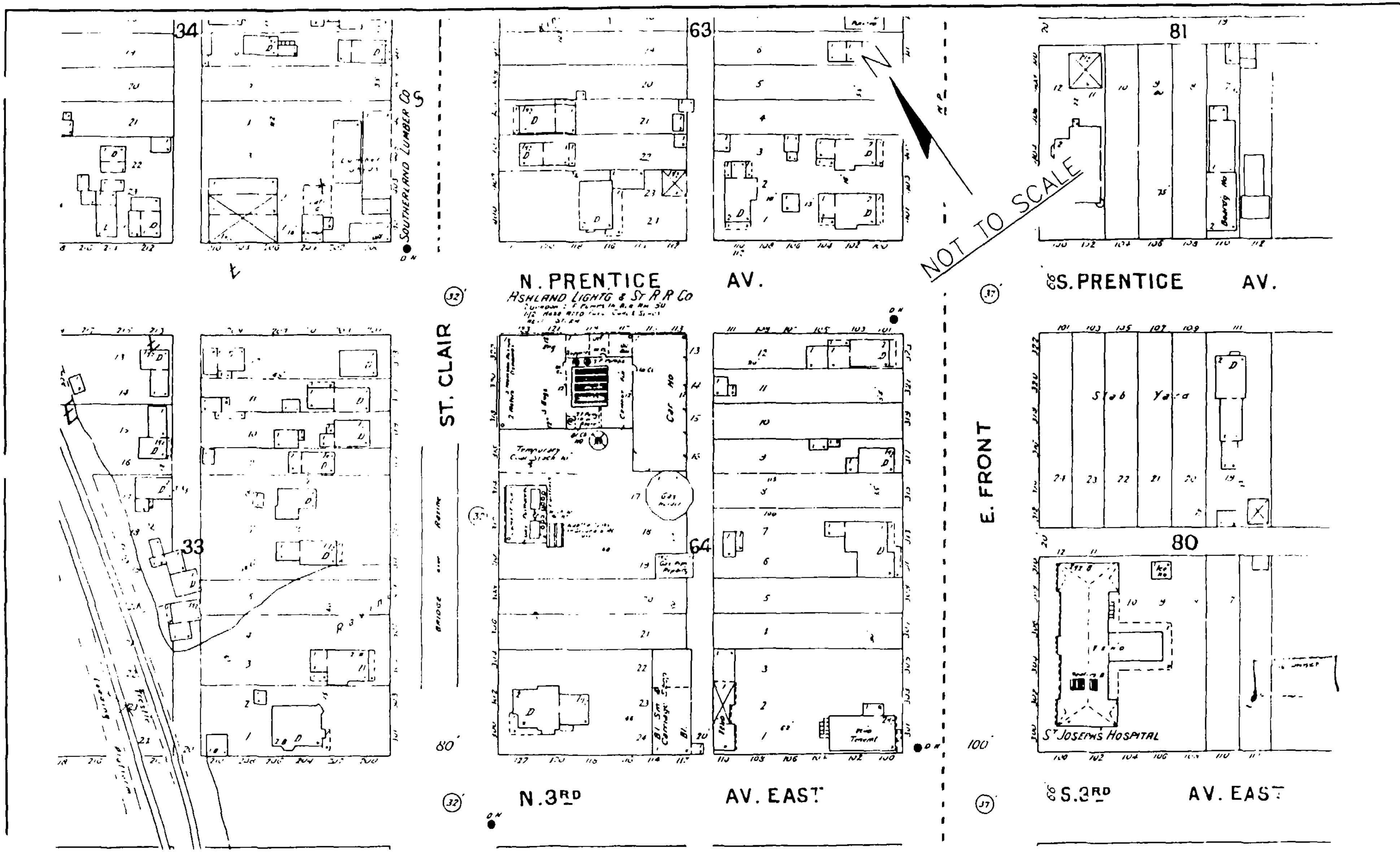

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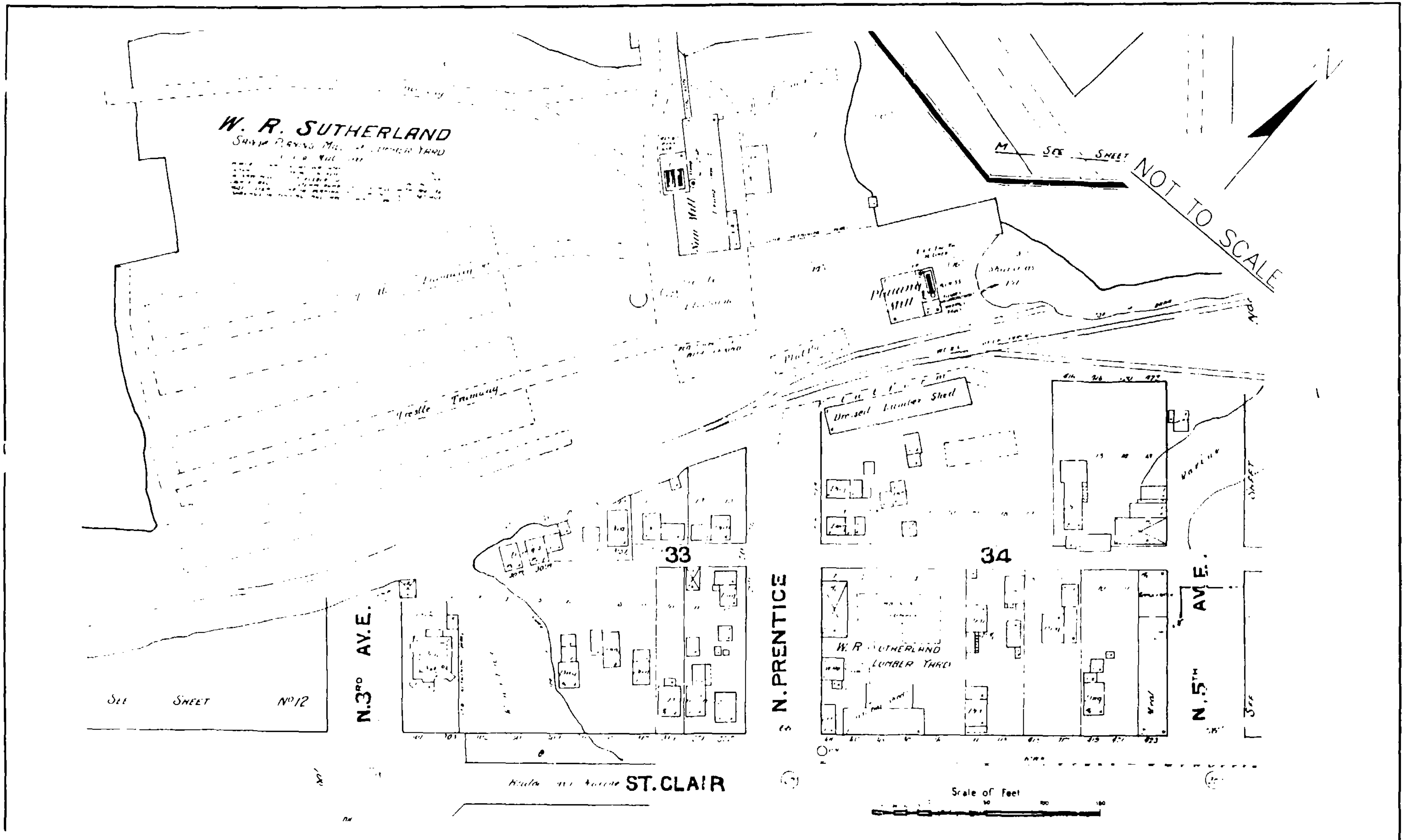

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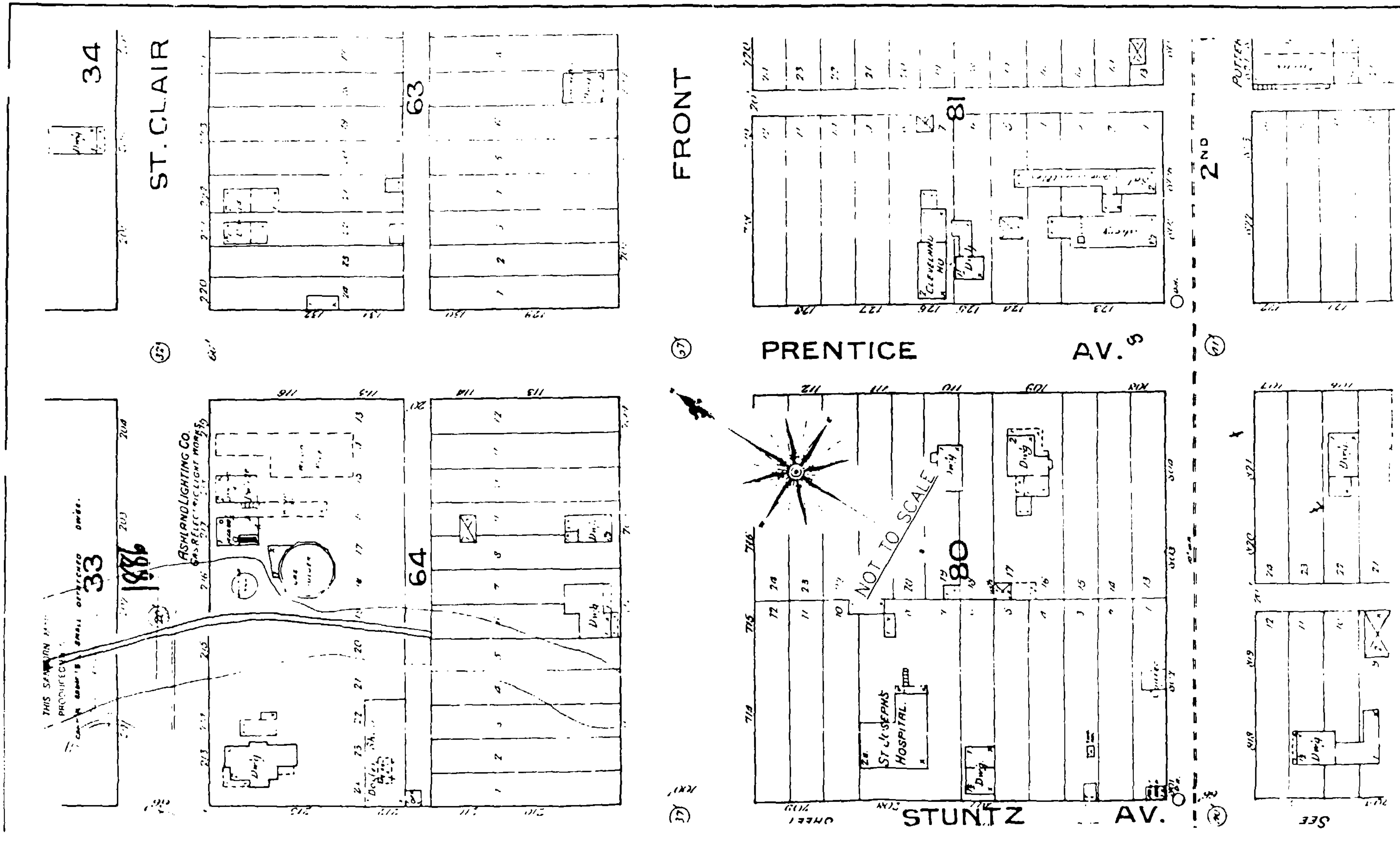

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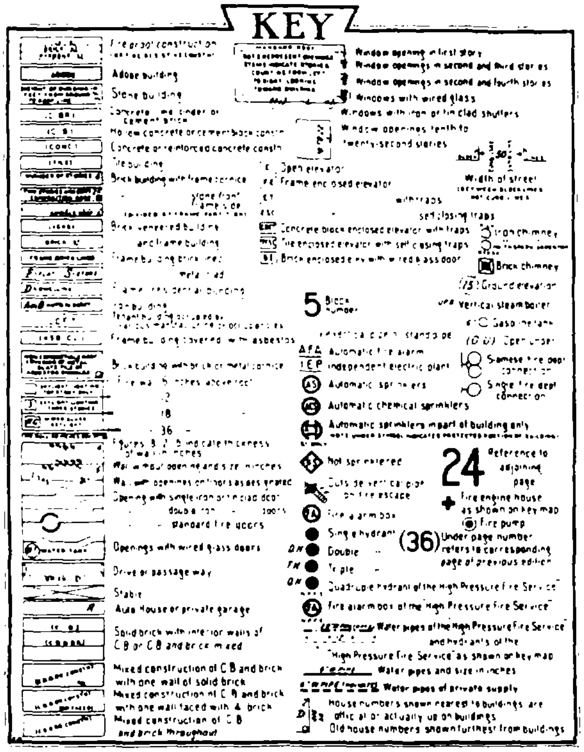
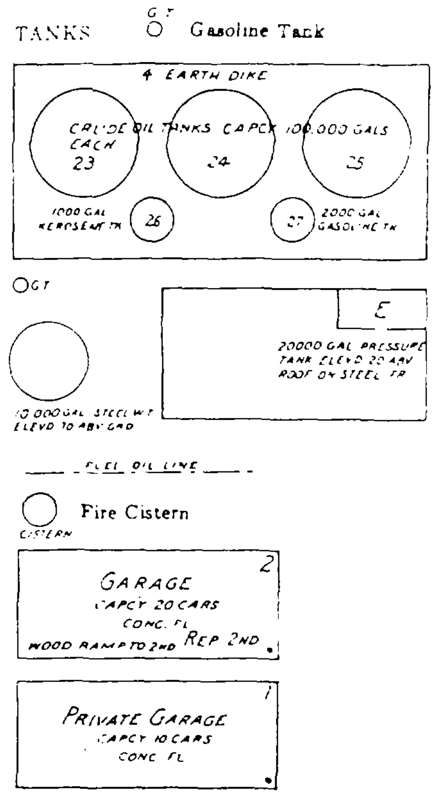
DATE 9401FZE1		RIDGE TOP

Appendix A

Sanborn Maps





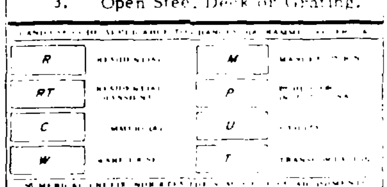
CODING OF STRUCTURAL UNITS FOR FIREPROOF AND NON-COMBUSTIBLE BUILDINGS

FRAMING

CODE	STRUCTURAL UNIT
A.	Reinforced Concrete Frame.
B.	Reinforced Concrete Joists, Columns, Beams, Trusses, Arches, Masonry Piers.
C.	Protected Steel Frame.
D.	Individually Protected Steel Joists, Columns, Beams, Trusses, Arches.
E.	Indirectly Protected Steel Frame.
F.	Indirectly Protected Steel Joists, Columns, Beams, Trusses, Arches.
G.	Unprotected Steel Frame.
H.	Unprotected Steel Joists, Columns, Beams, Trusses, Arches.
O.	Masonry Bearing Walls.

FLOORS

CODE	STRUCTURAL UNIT
1.	Reinforced Concrete. Reinforced Concrete with Masonry Units. Pre-cast Concrete or Gypsum Slabs or Planks.
2.	Concrete on Metal Lath, Incombustible Form Boards, Paper-backed Wire Fabric, Steel Deck, and Cellular, Ribbed or Corrugated Steel Units.
3.	Open Steel Deck or Grating.



ROOF

CODE	STRUCTURAL UNIT
a.	Reinforced Concrete. Reinforced Concrete with Masonry Units. Reinforced Gypsum Concrete. Pre-cast Concrete or Gypsum Slabs or Planks.
b.	Concrete or Gypsum on Metal Lath, Incombustible Form Boards, Paper-backed Wire Fabric, Steel Deck, and Cellular, Ribbed or Corrugated Steel Units.
c.	Incombustible Composition Boards with or without Insulation. Masonry or Metal Tiles.
d.	Steel Deck, Corrugated Metal or Asbestos Protected Metal with or without Insulation.

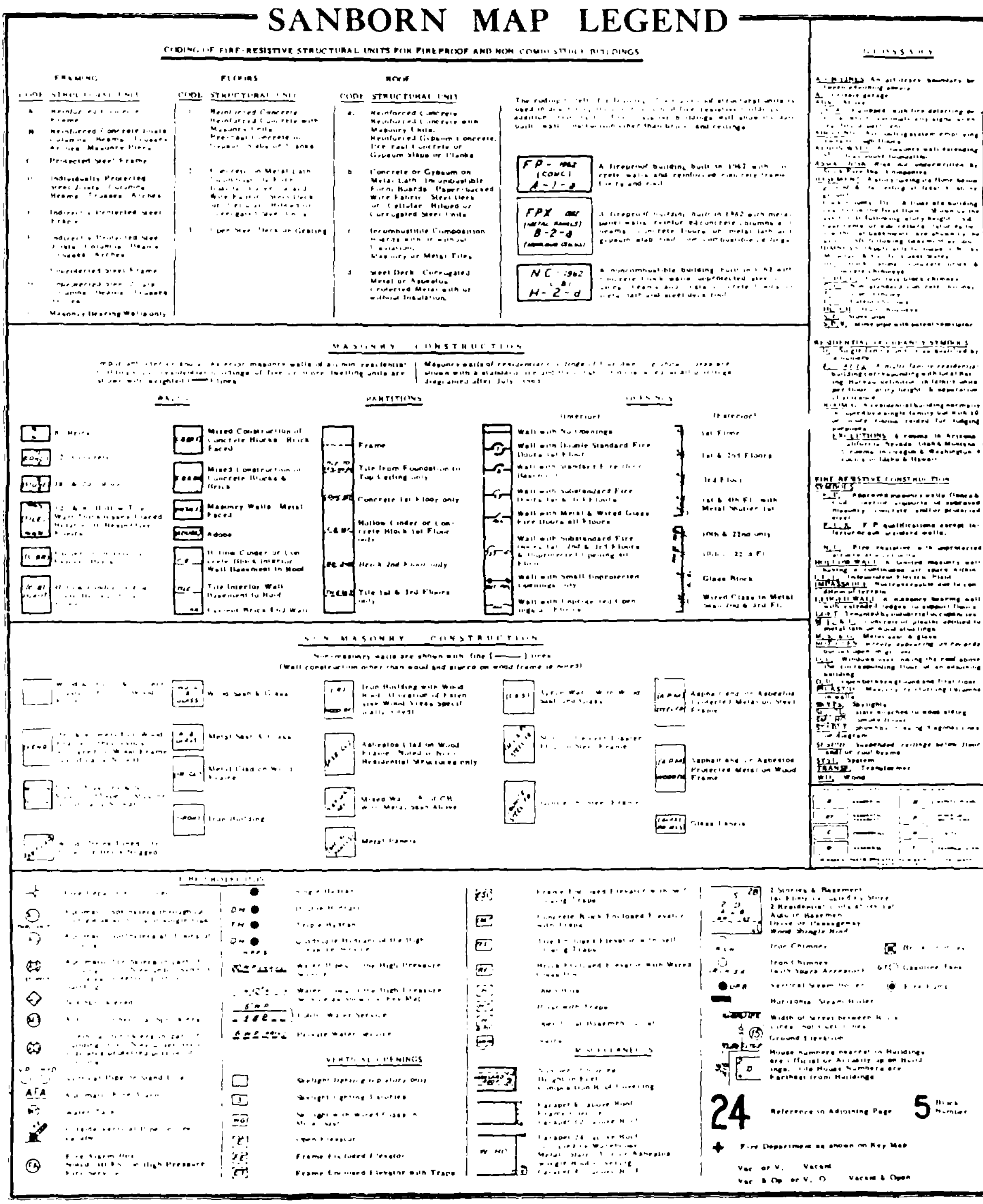
The coding for framing, floor and roof structural units as shown above is used in describing the construction of fire-resistive buildings. In addition, reports for fire-resistive buildings will show the date built and wall construction when other than brick.

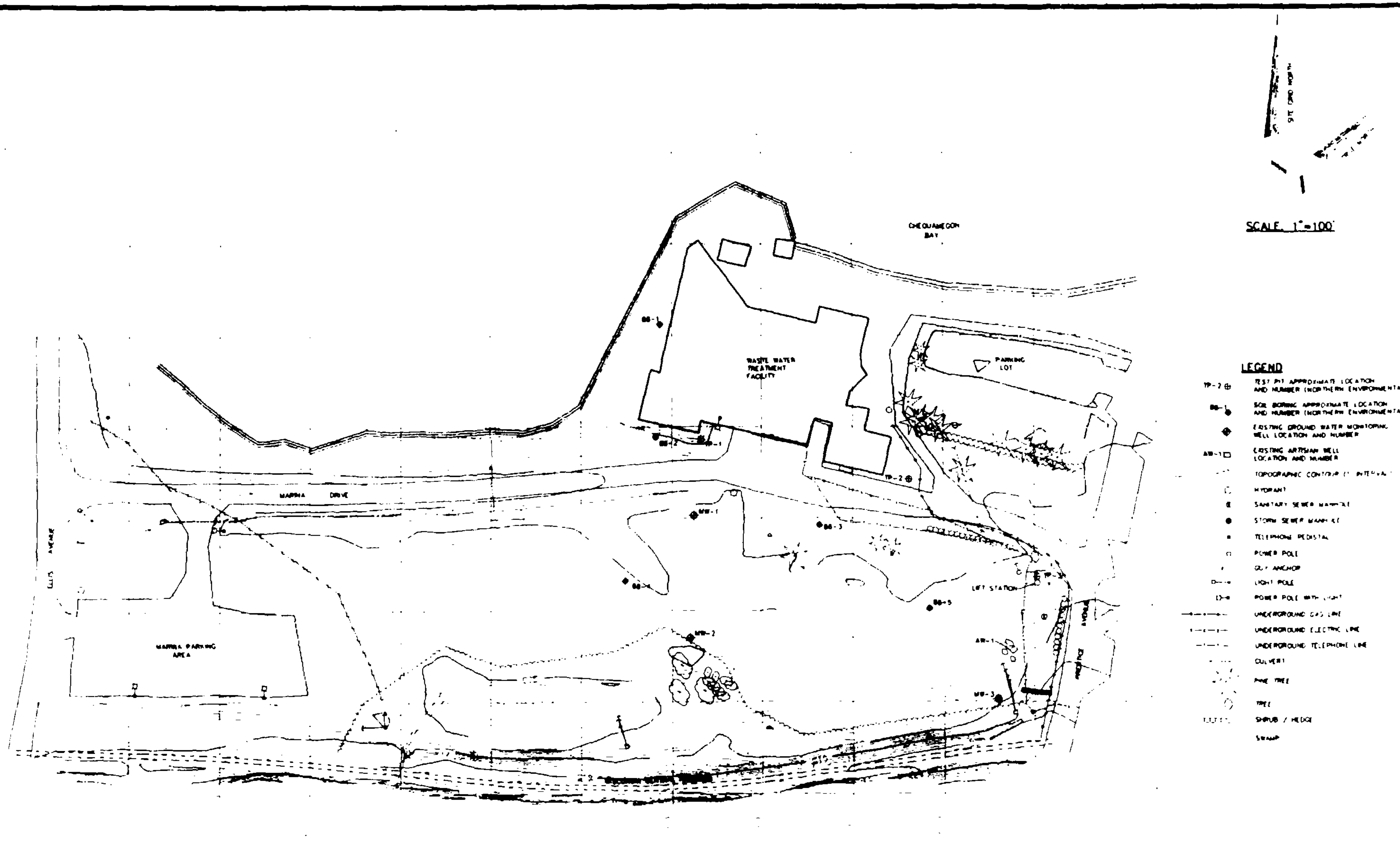
F P buildings have masonry floors and roof; concrete and/or directly or indirectly protected steel framing; and clay brick, stone or poured concrete walls.

F P X buildings are F P buildings with inferior walls such as concrete block, cement brick, metal or glass panels, etc.

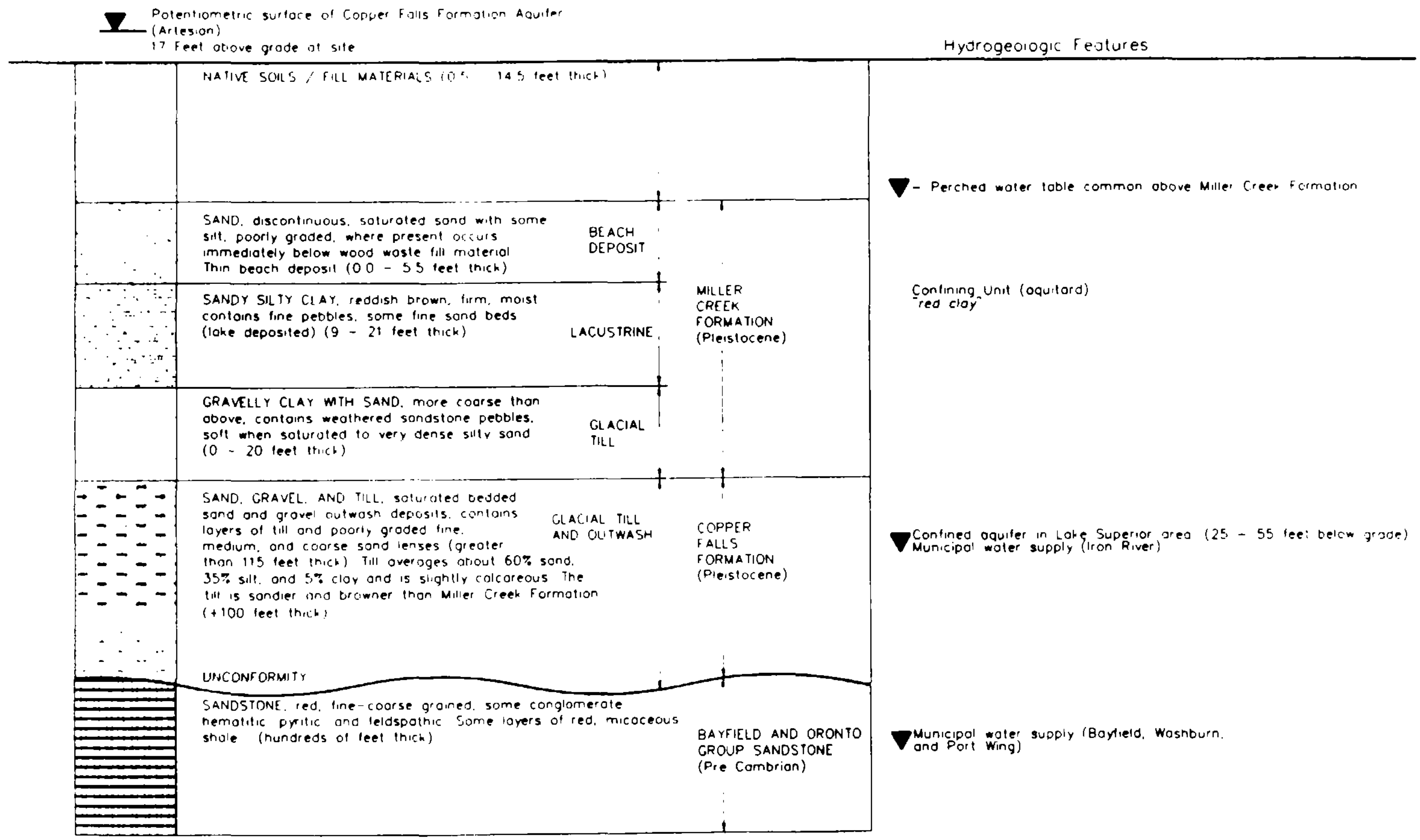
N C buildings have unprotected steel framing and fire-resistive but non-masonry floors and roof.

FP-1962 (CONC) A-1-a	A fire-resistive building built in 1962 with concrete walls and reinforced concrete frame, floors and roof.
FPX-1962 METAL PANELS E-2-b NONCOMB CEIL'G	A fire-resistive building built in 1962 with metal panel walls, indirectly protected steel frame, concrete floors and roof on metal lath, noncombustible ceilings.
NC-1962 (C B) H-2-d	A noncombustible building built in 1962 with concrete block walls, unprotected steel columns and beams, concrete floors on metal lath and steel deck roof.


SANBORN MAP LEGEND
FRAMING
FLOORS
ROOF
CODE STRUCTURAL UNIT
MASONRY CONSTRUCTION
WALLS
PARTITIONS
OPENINGS
NON-MASONRY CONSTRUCTION
GLOSSARY
24
Reference to Adjoining Page
5
Fire Department as shown on Key Map

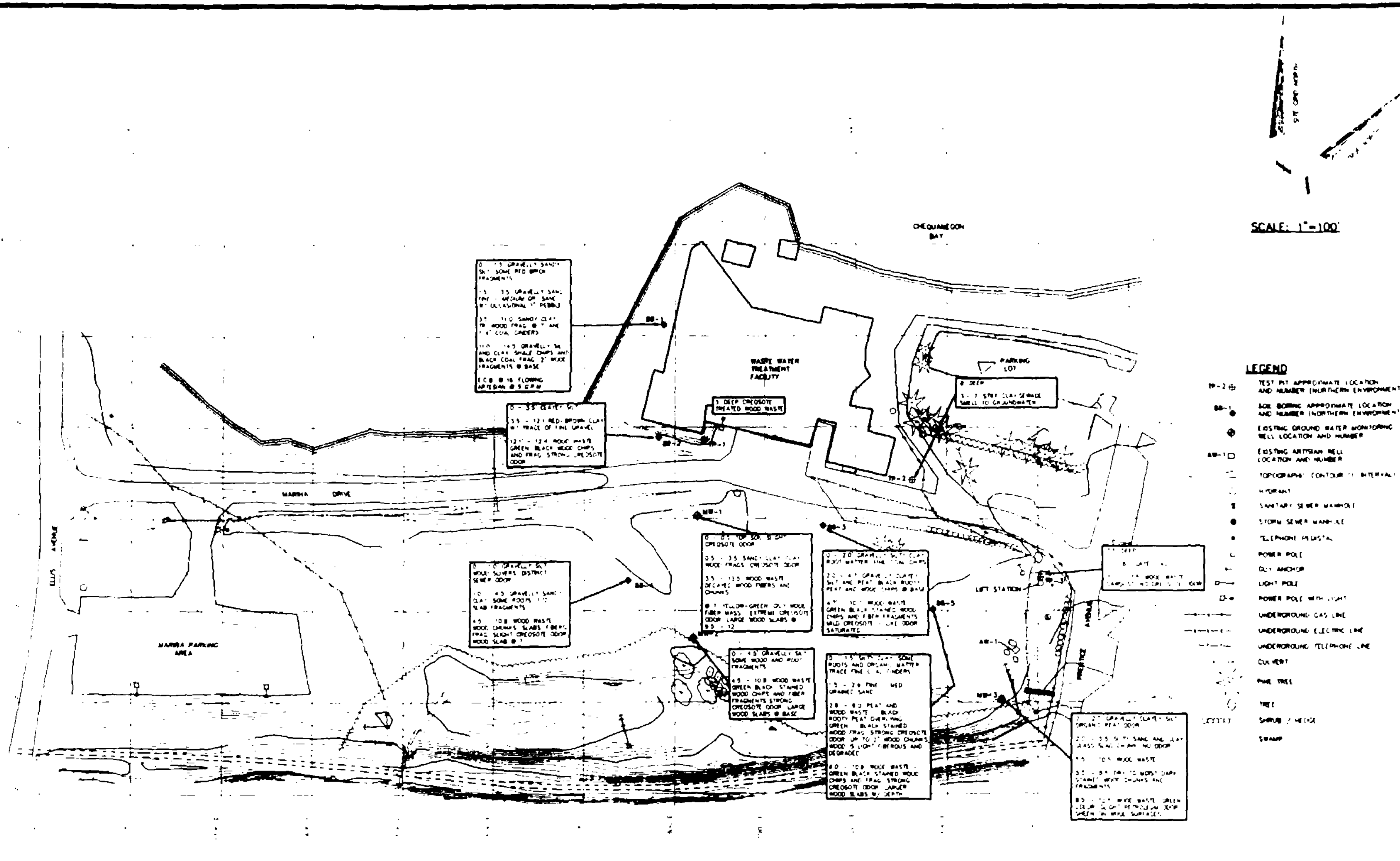


SEH ENGINEERS ARCHITECTS PLANNERS	DRAWN BY	CPE	08/08/94	FILE NO WIDNR9401	ASHLAND LAKEFRONT PROPERTY	FIGURE 2 SITE PLAN
	CHECKED BY	JG	8/22/94	DRAWING NO 9401FXE1		

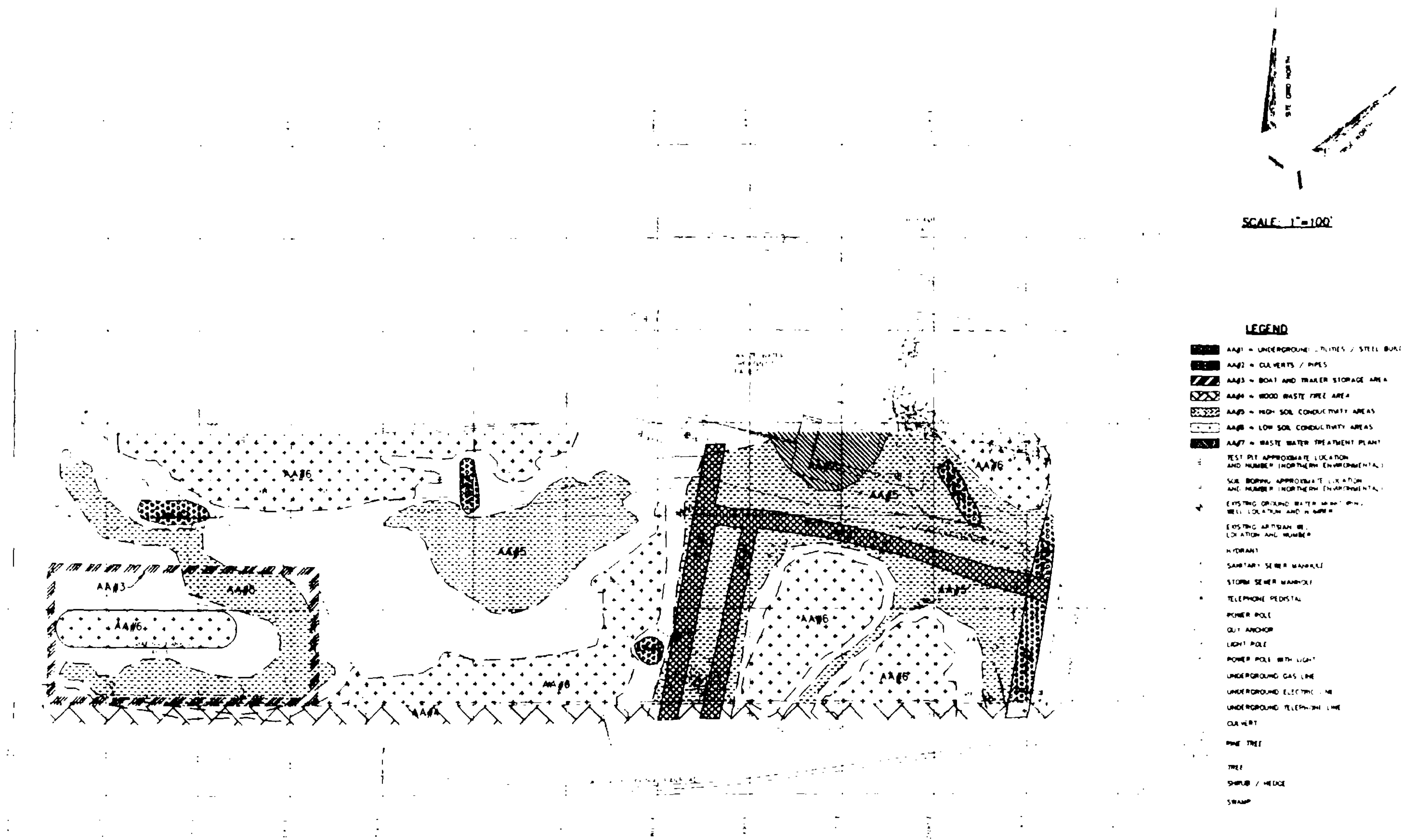


NOTE: Summarized from soil boring logs prepared by Northern Environmental Technologies Inc and from Regional Geologic information.

SEH ENGINEERS ARCHITECTS PLANNERS	DRAWN BY	AB/CE	08/02/94	FILE NO WIDNR9401	ASHLAND LAKEFRONT PROPERTY	FIGURE 3 STRATIGRAPHIC COLUMN
	CHECKED BY	DRR	8/22/94	DRAWING NO ASHSEC2		

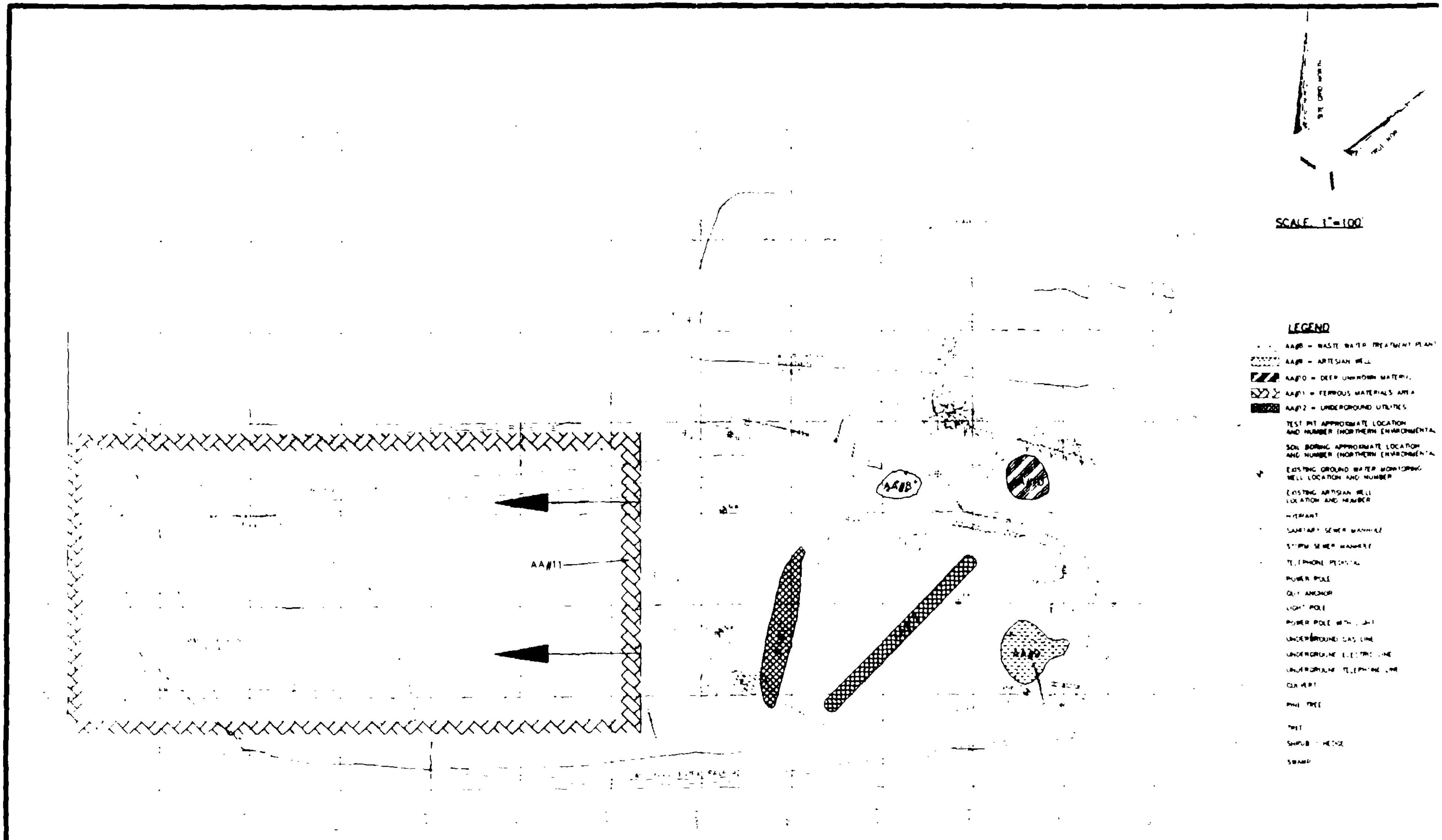


SEH	DRAWN BY:	CPE	08/08/94	FILE NO WIDNR9401	ASHLAND LAKEFRONT PROPERTY	FIGURE 4 SOIL BORING / TEST PIT LOCATIONS / DESCRIPTIONS
	CHECKED BY	JG	8/22/94	DRAWING NO 9401FXH1		



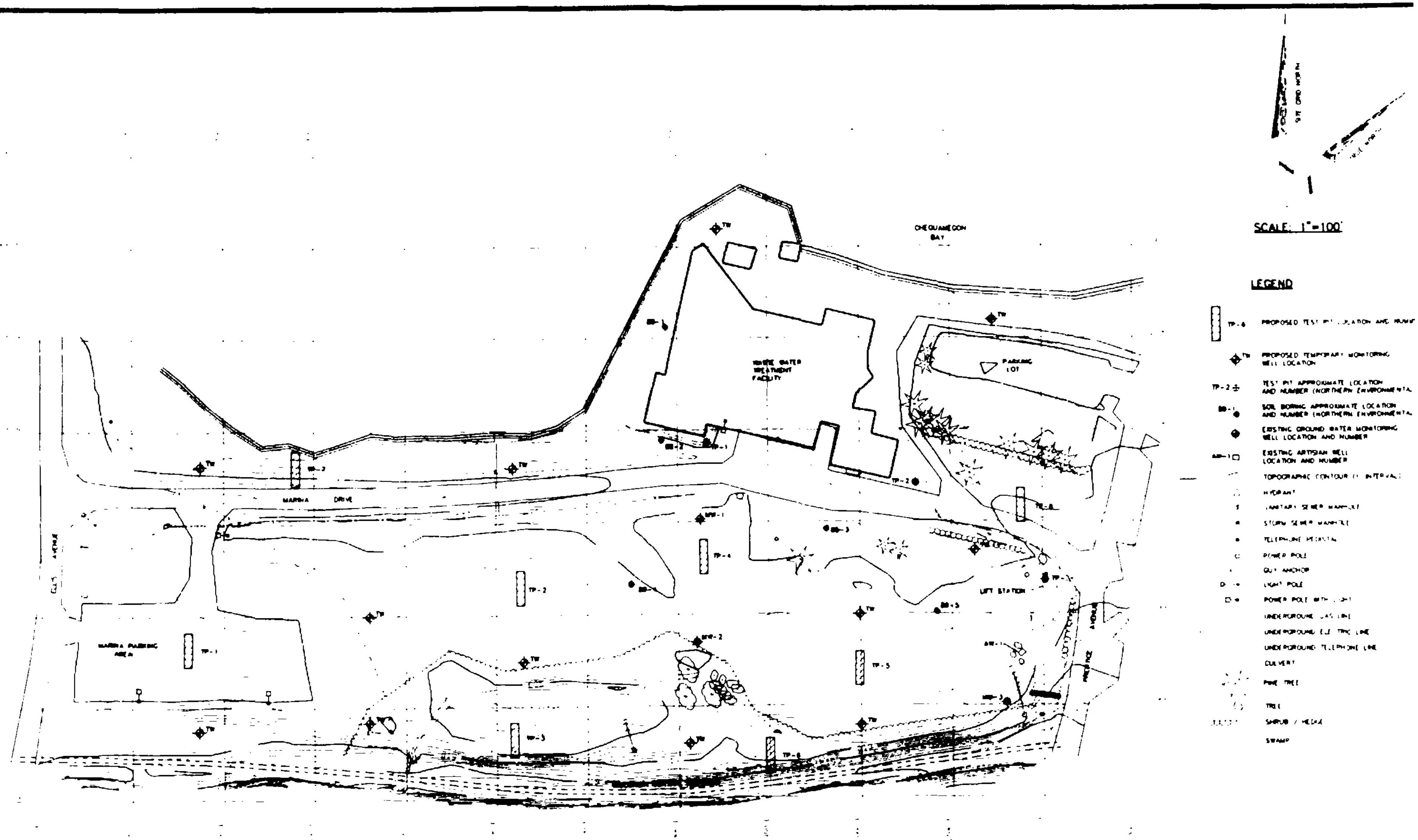
NOTE: SUMMARIZED FROM FROMM APPLIED TECHNOLOGY REPORT

SEH	DRAWN BY	CPE	08/08/94	FILE NO WIDNR9401	ASHLAND LAKEFRONT PROPERTY	FIGURE 5
	CHECKED BY	DRR	8/22/94	DRAWING NO 9401FGE1		EM 31 SURVEY ANOMALOUS AREAS MAP



NOTE SUMMARIZED FROM FROMM APPLIED TECHN... REPORT

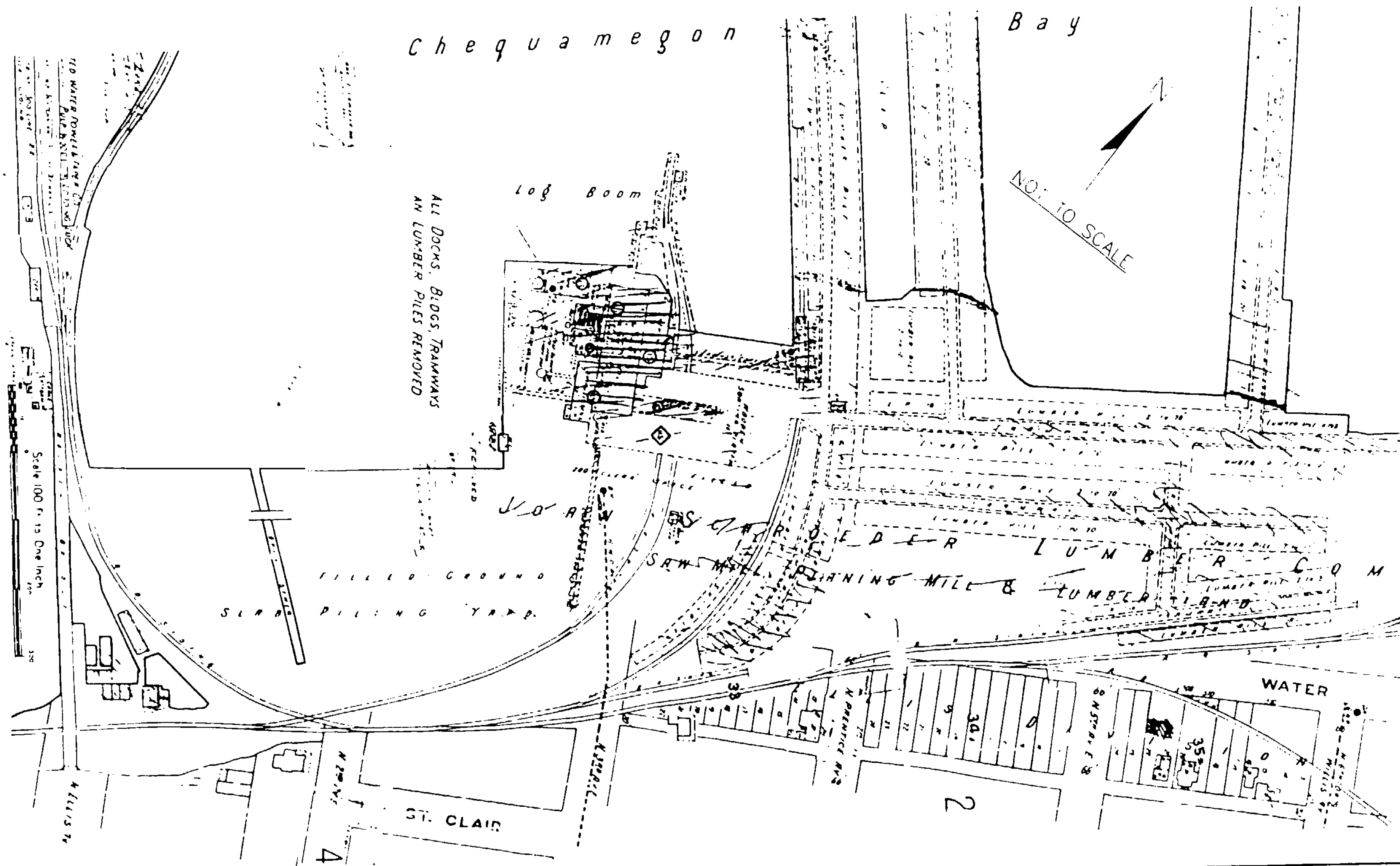
SEH ENGINEERS ARCHITECTS PLANNERS	DRAWN BY	CPE	08/03/94	FILE NO WIDNR9401	ASHLAND LAKEFRONT PROPERTY	FIGURE 6 MAGNETIC SURVEY ANOMALOUS AREAS MAP
	CHECKED BY	DRR	8/22/94	DRAWING NO 9401FGE2		



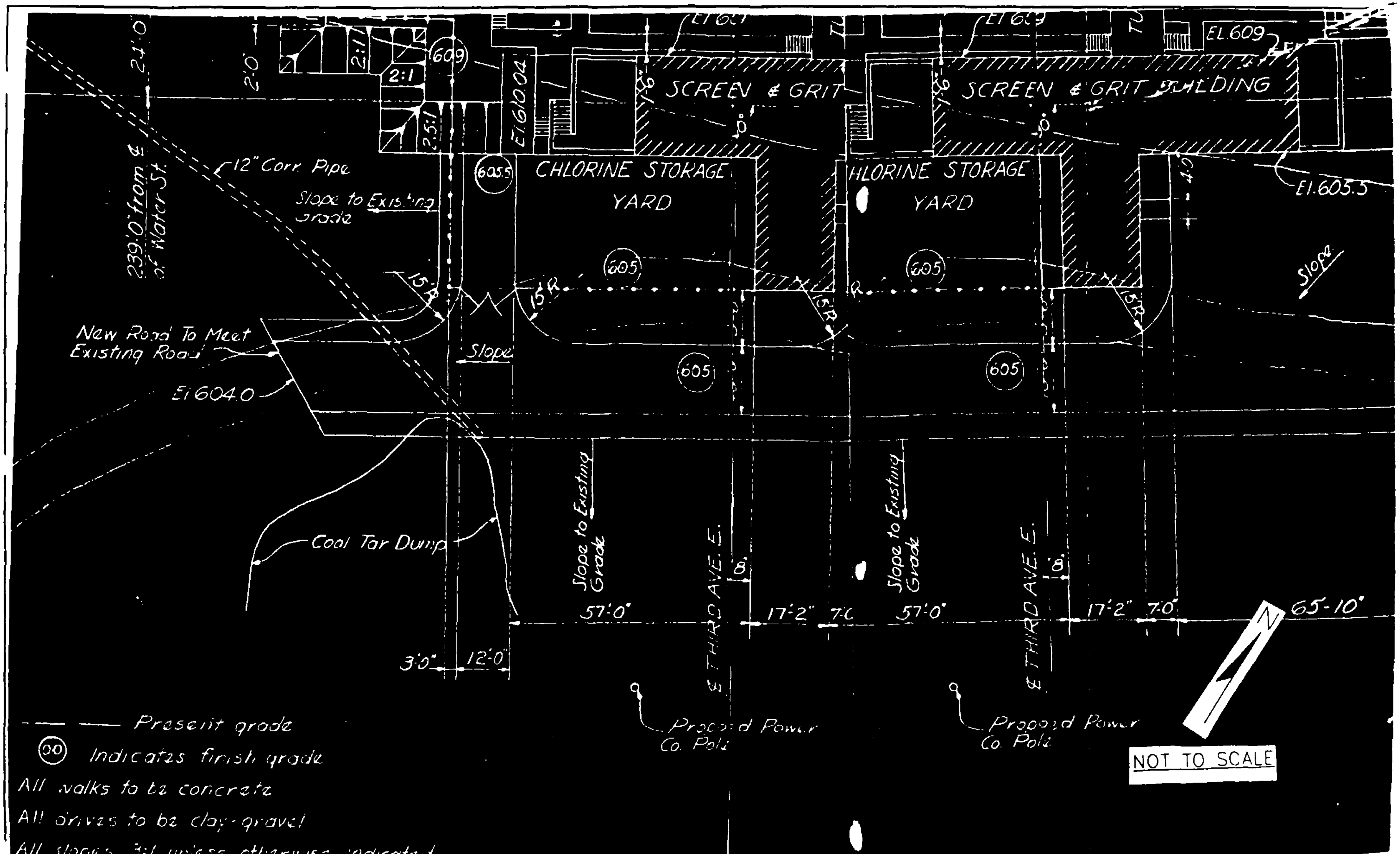
SEH	DRAWN BY	CPE	08/08/94	FILE NO WIDNR9401	ASHLAND LAKEFRONT PROPERTY
	CHECKED BY	JG	8/22/94	DRAWING NO 9401FXH2	FIGURE 7 PROPOSED TEST PIT / TEMPORARY WELL LOCATIONS

Appendix B

Greeley and Hansen 1951 Site Plan



SEH	FILE NO WIDNR9401 DATE 9401FZE1	CITY OF ASHLAND – SANBORN MAPS	1951 LOWER FILL AREA



SEH	FILE NO WIDNR9401 / DATE 9401FZE2	WASTE WATER TREATMENT PLANT DESIGN DRAWING	1951 GREELEY & HANSON ENGINEERING CHICAGO, ILLINIOS

Appendix C

Fromm Applied Technology Report

Fromm Applied Technology
13129 N. Green Bay Road
Mequon, Wisconsin 53092
(414)242-4280

July 27, 1994

Mr. Cy Ingraham
SEH, Inc.
421 Frenette Drive
Chippewa Falls, Wiscsonsin 54729

Dear Cy:

Attached is the preliminary submittal of the report on the geophysical surveys conducted at the Ashland Creosote Pit Project, which we called the Marina Drive Site in the report. Please review the document and call me if you have any questions.

Sincerely,

Arthur J. Fromm

kaf

Report on the Geophysical Surveys Conducted

at the

Ashland Creosote Pit/ Marina Drive Site Ashland, Wisconsin

for

SHORT ELLIOTT HENDRICKSON, Inc.
(SEH, Inc.)
Chippewa Falls, Wisconsin

by

Fromm Applied Technology
Mequon, Wisconsin
July 20, 1994

ABSTRACT

To assess the subsurface characteristics of waterfront property in Ashland, WI, identified in this report as the Marina site, electromagnetic and total field magnetic surveys were conducted. The objectives of the geophysical surveys were to characterize the fill material (cover material and the wood waste) and to define the extent of all detectable buried metal within the area. The electromagnetic results defined major zones of high and low electrical conductivity. With respect to several assumptions and while unique interpretations were not possible, the low conductivity areas represented zones of increasing cover material or the presence of organic liquids within the wood waste. The high conductivity areas represented zones of thin cover material or the relative lack of organic fluids within the saturating fluids. A modest auguring program should supply the parameters necessary to remove the interpretational non-uniqueness. The electromagnetic results also defined the locations of various underground utility lines and culverts. The magnetic results separated the site into two major areas. In one of these areas, it appears that ferrous material is absent, small, and/or relatively deep. The other area contains ferrous material, which is interpreted to be relatively small and shallow.

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LIST OF FIGURES

INTRODUCTION

Background

During the period of July 5 through July 9, 1994, electromagnetic and magnetic surveys were conducted at the Ashland Creosote Pit site located in Ashland, Wisconsin. In the this report the project is referenced as the Marina Drive Site. The site is approximately 8 acres in size and is predominately an unwooded city park. Before approximately 1920, a sawmill was operated at the site. In 1951, a waste water treatment plant was built near the shoreline of lake Superior. On the basis of previous environmental reports indicating the presence of creosote and historic records describing earlier fill operations, it was found necessary to recharacterize the site. The geophysical program is intended to non-intrusively determine the presence of geophysically detectable buried metal and to attempt to delineate anomalous zones within in the wood waste fill area.

The site consists primarily of fill over soils of the Miller Creek Formation. As described in a previous report, the fill material is typically wood waste covered by silty clay mixed with various debris. Beneath the fill, the soil profile would consist of sand, sandy silty clay, gravely clay with sand. Artesian conditions exist at the site; however the water table is typically above the Miller Creek Formation, within the fill.

Objectives

The objectives of the geophysical surveys are to delineate geophysically detectable buried metal and to identify lateral variations of the fill material that may be associated with a previous wood preserving process using creosote. The anomalous zones indicating buried metal could be associated with, but are not limited to, drum disposals, underground utilities, and sewer lines. Understanding the survey area is located on a manmade terrace, which is bounded by a bluff and Lake Superior, the geophysical surveys are not intended to determine the limits of fill.

The objective of the electromagnetic (EM31) survey is to map variances in apparent electrical conductivities and inphase responses in both the vertical and horizontal dipole modes. These variances are expected to delineate zones that differ from background. It was anticipated that the electromagnetic properties of the landfill material, large zones saturated with creosote, and buried utilities would differ significantly from the properties of the native soils. Hence, the extent of these features should be defined by EM isopleth maps.

The objective of the magnetic survey is to define the location of buried ferrous metal. The magnetic survey is expected to supplement the EM results. Magnetic methods are typically more sensitive to discrete ferrous metal objects at greater depths than are EM31 methods. It should be noted that the depth of investigation of the magnetic method is dependent on the size and geometry of the ferrous object(s).

INSTRUMENTATION AND THEORY

The electromagnetic survey implemented Geonics' EM31 terrain conductivity system. The EM31 system was operated in the vertical and horizontal dipole modes. All measurements were electronically stored on an attached data logger. A brief introduction to electromagnetic theory is presented in **Appendix A: Overview of Electromagnetic Surveys**.

The magnetic survey was conducted with an EG&G G-856 proton precession magnetometer. The instrument employed two sensors, essentially allowing the simultaneous measurement of both the total magnetic field and the vertical gradient of the total field. Measurements are recorded in the magnetometer's internal memory. A brief introduction to magnetic theory is presented in **Appendix B: Overview of Magnetic Surveys**.

METHODOLOGY

The rectangular coordinate system and ground control referenced at the site was established by SEH, Inc. The local coordinate system, measured in distance north and east, was established with the Y-axis pointing approximately 35 degrees west of north. The X-axis is measured in distance east and extends from 1130 East to 2240 East. The Y-axis is measured in distance north and extends from 1880 North to 2180 North. The discussion and graphs presented in this report reference this preexisting coordinate system. A base map for the site is presented in **Figure 1: Marina Drive Site--Modified Base Map.** This figure demonstrates the range and orientation of the coordinate system and many of the surface features. At the time of this report, a validated base map was not yet available.

SEH personnel provided ample ground control by typically marking the ground with orange spray paint on survey lines spaced 30 feet apart. Each survey line consisted of stations marked ten feet apart. This ground control allowed Fromm Applied Technology personnel to easily place a sufficient amount of fiberglass pin flags to conduct the geophysical surveys. This flagging allowed EM31 and magnetometer readings to be obtained throughout the entire survey area on ten foot centers.

An EM base station was reoccupied at 1520E 2120N approximately every hour during survey periods to demonstrate repeatability and to minimize the possibility of instrument drift. This station was also used for the initial setup and daily calibration of the instrument, per manufacturer's recommendations. After the initialization of the instrument, the EM31 was not turned off until the end of the day. At each EM31 station, both conductivity and inphase measurements were obtained. Measurements were recorded at waist height, unless an obvious indication of buried metal was noted by placing the instrument at ground level. In addition, the orientation of the instrument varied from north–south to east–west, depending on whether a direct indication of buried metal could be recorded.

At each magnetometer station, measurements of the total magnetic field and the vertical gradient of the total field were recorded. The sensors were mounted approximately 1.6 meters and 0.6 meters above ground level. To remove temporal variations from the magnetic data, a base station was maintained at 1700E 2000N. This area appeared magnetically quiet, uninfluenced by cultural features, and to represent a magnetically stable area with small horizontal gradients. The magnetic field at this location was measured approximately every hour. The base station measurements were then interpolated to yield the base station reading at the time of each survey site measurement. All total field residual values reported are the residual difference between the interpolated base station measurements and the survey site measurements. Both the EM31 and magnetic surveys were consistent with the intent of methodologies defined in the Department of Energy document DOE/HWP-100, Geophysical SOPS, attached as **Appendix C**.

It is worth noting the methodology used in presenting the isopleth maps. The contour interval varied in each diagram to enhance the coherency of the delineated anomalies. In the isopleth plots, one will note that areas have not been "blanked out." Hence, computer extrapolated contour lines may extend into unsurveyed areas. Areas that have questionable validity are not intentionally addressed in this report. Computer extrapolated areas can be located by determining where contour lines may have extended beyond surveyed areas. The surveyed areas are best defined by referencing the position of each station, which is presented in **Figure 2: Marina Drive Site--Occupied Geophysical Stations**. Because contouring may distort the field data **the location and extent of any anomaly should be substantiated by referencing the original data set** (see appendices).

Geophysical Assumptions

In a geophysical site characterization as the one performed at this site, it was understood from the beginning that no one method would clearly answer all the questions about the site. If certain assumptions were made and held true, each method of investigation should yield desirable results. There was a high level of confidence that EM31 and magnetometer measurements would delineate zones of interest within the fill area and detect relatively large buried utilities, assuming minimal cultural interference (i.e. buildings, fencing, and demolition debris). Neither of these methods were expected to deliver a high level of confidence for determine quantitatively the depth to a detected source material. Buried metal is assumed to be near the surface, approximately less than ten feet, and large enough for the EM31 to detect. The success of the magnetometer survey is based on the presence of ferrous material, which is usually associated with landfills.

The relationship between the horizontal and vertical dipole measurements are expected to qualitatively identify the thickness of the upper unsaturated fill material and to differentiate between zones of high and low conductivities. To detect a pit used for treating wood with creosote, an electrical contrast between the pit area and the upper fill material and wood waste must be present. This condition probably exists if the pit has been filled with metal, clay soils (mineralogically), or is thoroughly saturated with creosote, which would have displaced the ground water from within the wood waste surrounding the pit area. Also, the entire site can not be equally saturated with creosote. A distinct contrast must exist. The pit is not expected to be detected, if the pit area is not very thick or if the pit is not spatially large enough to detect.

RESULTS

EM31 Survey

The EM31 can be operated in either the vertical or horizontal dipole modes. The depth of investigation is greater for the vertical dipole mode than for the horizontal dipole mode. Both modes were employed at each station for this study. All data obtained during the survey is tabulated by station location and attached as **Appendix D: Marina Site – EM31 Data**.

A color coded contour map of the measured electrical conductivities obtained with the EM31 in the vertical dipole mode is presented in **Figure 3: Marina Site—Contour Map of EM31 Vertical Conductivities.** In this figure, the green contour lines represent conductivities of 0 millimhos per meter or less, the black contour lines range from 10 to

25 millimhos per meter, the blue contour lines represent conductivities between 27 and 30 millimhos per meter, and the red contour lines are for conductivities of 35 millimhos per meter or greater. The negative apparent conductivities, green contour lines, result from the presence of buried metal.

The metal associated with underground utilities or drainage lines usually produces a linearly trending negative conductivity contours. The generally north--south trending negative anomaly extending from 1820E 1880N to 1870E 2180N is an example of an interpreted utility. This anomaly may result from a water supply line to the abandoned waste treatment plant. The parallel negative anomaly from 1870E 1880N to 1910E 2100N is likely a buried utility line of unknown purpose. Either of these lines may join with another line extending from 1860E 2100N to the steel building located at 2220E 2030N. While this negative anomaly does break up, it is interpreted to be a continuous feature. The short negative anomalies centered at 1270E 2100N, at 1600E 2140N, and at 2130E 2140N result from visible steel culverts. The longer negative anomaly extending from 2190E 1880N to 2240E 2090N is also thought to result from a culvert.

Measurements in the southwest portion of the site were compromised by the presence of numerous boats and boat trailers. The area of compromised measurements appeared to extend in the north-south direction from 1900N to 2050N and from the eastern border, 1130E, to 1430E. The negative anomalies within this region probably result from the boat trailers. The southern edge of the site is a heavily vegetated topographic low near lake elevation. Based primarily on elevation, this area is assumed to be free of a significant wood waste layer. The apparent electrical conductivities south of 1900N, observed in the vertical dipole mode, are approximately 20 millimhos per meter. Hence, apparent conductivities, observed in the vertical dipole mode, in the range of 15 to 20 millimhos per meter are interpreted to be area background values and represent the absence of any wood waste. These background values may also be observed, to a limited extent, along the northern edge of the site, which is coincidental with the area north of Marina Drive.

Discounting the negative conductivities, the site can be characterized by areas with apparent soil conductivities of 35 millimhos per meter or greater, areas with apparent soil conductivities of 25 millimhos per meter or less, and transition zones between these areas. The variable contour intervals used in Figure 3 were selected to display this characterization. The red contour lines enclose areas of high soil conductivity, the black contour lines enclose areas of low soil conductivity, and the blue contour lines define the transition zones.

A color coded contoured map of the measured electrical conductivities obtained with the EM31 in the horizontal dipole mode is presented in **Figure 4: Marina Site--Contour Map of EM31 Horizontal Conductivities.** The linear negative conductivities, interpreted as, resulting from underground utilities and drain lines are not evident in this figure. This is usually associated with the shallow depth of investigation of the horizontal dipole mode. The horizontal dipole results are very similar to the vertical dipole results. The site can be characterized by areas with apparent soil conductivities of 25 millimhos per meter or greater, areas with apparent soil conductivities of 15 millimhos per meter or less, and transition zones between these areas. The variable contour intervals used in Figure 4 were also selected to display this characterization. The red contour lines enclose areas of high soil conductivity, the black contour lines enclose areas of low soil conductivity, and the blue contour lines define the transition zones. The difference between the vertical and horizontal mode apparent conductivities used to achieve this characterization result from the difference in investigation depths of the two modes.

The results of the EM31 vertical dipole inphase measurements are presented in **Figure 5: Marina Site—Contour Map of EM31 Vertical Inphase Response**. The inphase values, measured in parts per thousand directly from the instrument, are derived by a comparison of the primary and induced electromagnetic fields as outlined in **Appendix A**. These measurements can be of value in detecting ferrous or nonferrous metal and also serve for general quality control. In the presence of metal, the inphase response is normally associated with values abnormally above or below background values. The background inphase response for the site is interpreted to be approximately 0 ppt, the blue contour lines in Figure 5.

The areas enclosed by red contour lines in Figure 5 are areas of abnormally high inphase response. With the exception of the anomalies seen at 2230E 2030N and 2000E 2150N, these high values of inphase response appear to outline underground utility lines or parked boat trailers, as noted in the vertical dipole conductivity results seen in Figure 3. Respectfully, the two exceptions are thought to be associated with a steel building and the waste water treatment plant. The abnormally low values of inphase response, the green contour lines in Figure 5, are concurrent with known culverts. The negative inphase response at 1800E 1950N apparently results from a horizontal piece of 15 inch steel pipe. While the sources for the remaining negative values of inphase response are not generally known they are probably associated with small surface or shallow pieces of metal.

The results of the EM31 horizontal dipole inphase measurements are presented in **Figure 6: Marina Site—Contour Map of EM31 Horizontal Inphase Response**. These results simply enhance the above EM31 measurements. They do not appear to add any additional information to the site characterization.

Total Magnetic Field Survey

The magnetic data obtained during the survey is tabulated by station location and attached as **Appendix E: Marina Site—Magnetic Data**. A color coded map of the total field magnetic results is presented in **Figure 7: Marina Site—Contour Map of Residual Total Magnetic Field**. The magnetic results are responding entirely to the presence of ferrous material and are independent of stratigraphic changes. The typical response is a maximum peak accompanied by an associated minimum trough. The magnitude and extent of the response reflects the size, depth, and orientation of the ferrous material. The results presented in Figure 7 are typical for small and shallow ferrous object. The maximum anomalies, red contour lines in Figure 7, are generally associated with magnetic lows, the green contour lines. A possible exception, is the large negative anomaly centered at approximately 2020E 2130N. This anomaly appears to be related to the waste water treatment plant and the expected maximum response may be degraded by the building.

The vertical gradient of the total magnetic field observed throughout the area, in gammas per meter, is presented in **Figure 8: Marina Site—Contour Map of Total Field Vertical Gradient**. High values of the gradient are interpreted to imply the metal is shallow and near the measurement station.

There are two major anomalies in Figure 7 with unaccountable sources. The anomaly centered at approximately 2180E 1950N is very close to the public artesian well located on the property. However, the building is made of wood and the 1 inch well pipe is too small to account for the anomaly. It is possible that a very large well casing is producing the anomaly, and the vertical gradient, Figure 8, is consistent with this idea, but the presence of any casing was not confirmed. The positive anomaly centered at 2160E 2140N, Figure 7, has no clear and obvious source. The gradient at this location, Figure 8, is low, which implies that the source material is relatively deep.

CONCLUSIONS

The electrical conductivity surveys clearly defined a number of underground utility lines and culverts. The features are the linear trending green contour lines in Figure 3. The trends and, where possible, the origins of these features were discussed in the Results section. Other than the effects of the underground utility lines and culverts, the site can be electrically characterized with the EM31 vertical dipole data as consisting of areas with apparent conductivities of 35 millimhos per meter or greater, areas with apparent conductivities of 25 millimhos per meter or less, and transition zones between these areas. The variable contour intervals used in Figure 3 were selected to display this characterization. An area of high conductivity, centered at approximately 1650E 2080N, is enclosed by red contour lines. An area of low conductivity, centered at approximately 2000E 1980N is enclosed with a black contour line. A similar low conductivity area to the west, that could be referenced by coordinates 1790E 2000N, is enclosed by a black contour line. These two areas may be contiguous. However, they are separated by anomalous values that may result entirely from dominating underground utility lines.

The site could also be electrically characterized by the EM31 horizontal dipole data. In this case, the apparent conductivities that characterize the soils are slightly different, which may reflect the shallower depth of investigation in the horizontal dipole mode. Spatially, the interpreted regions are approximately the same. In Figure 4, there is a high apparent conductivity area centered at 1650E 2080N and low conductivity areas centered at approximately 2000E 1980N and 1790E 2000N.

Electrical depth soundings or electrical well logs were not available for the site. The available boring results were placed in areas identified geophysically as transition zones. Hence, unique interpretations are not possible. Qualitatively, the high and low conductivity areas differ significantly. On the basis of correlating the available boring logs with observed conductivities and assuming the wood waste is present throughout the site, it appears the conductivity of the wood waste is greater then the cover material. In addition, if it is assumed that the basal elevation of the fill material and the elevation of the water table remains fairly constant, it is highly probable that the varying conductivities are from a change in pore fluid conductivity, a change in the thickness of the cover material, or a combination of these two effects. Interpreting the first two effects independently yields the following possibilities.

1. Within the low conductivity areas, organic fluids may be a significant part of the pore fluids associated with the wood waste. The presence of the non-conducting organic fluids would lower the bulk conductivity of the wood waste, which would serve to lower the measured apparent conductivities. Under these conditions, the previously noted low conductivity areas would represent the areas of highest organic contamination. The areas of high apparent conductivity would result from the presence of water saturated wood waste relatively free of organic contamination. The transition zones would represent the transition between the clean and contaminated zones. Numerical analysis, based on the available boring results within the areas of interest, indicated that this model is physically reasonable.

2. If the pore fluid conductivity does not change significantly, the observed results must be accounted for through a change in the thickness of the surface material, assuming the cover material is a low conductivity layer. Again, if the water table

and basal elevation of the fill material are assumed constant, a decrease in conductivity is equivalent to a decrease in the thickness of wood waste material. Areas of low conductivity, the black contour lines in Figures 3 and 4, would then imply an increase in thickness of the cover material. Areas of high apparent conductivity would imply a thin layer of cover material. The transition zones would result from areas of varying cover material thickness.

The total field magnetic results, Figure 7, appear to divide the site into two distinct regions. West of a north-south line at approximately 1730E, the results are a chaotic set of isolated short wavelength events. These events group together to form approximately a 200 foot diameter zone centered at 1570E 2000N, which may extend towards the northwest to the shoreline. The nature of these anomalies would suggest the presence of numerous small ferrous objects that are all shallow. While each of the anomalies west of this line indicate the presence of ferrous material, only modest concentrations appear evident. The gradient results west of approximately 1730E are also isolated sets of chaotic anomalies. This is consistent with the presence of small and shallow ferrous material.

East of a line at approximately 1730E the magnetic character of the site is distinctly different. As noted in the Results section, this area contains two major anomalies of unknown origin. These anomalies are centered at 2180E 1950N and at 2160E 2140N. The major negative anomaly centered at 2020E 2130N appears to be associated with the waste water treatment plant but may involve buried ferrous material outside the plant's foundations. The long wide linear north--south anomaly centered along 1890E is apparently an underground utility, which was better defined by the EM31 data. With the exception of these four anomalies, the area east of 1730E does not contain the small, chaotic, isolated, and short wavelength anomalies that are clearly evident west of this line.

The vertical gradient results, Figure 8, are very similar to the total field results. In this case there is a diagonal line extending from 1670E 2180N to 1930E 1880N that appears to separate the two different regions. West of this dividing line, the gradients are isolated and chaotic. East of this line the gradients are less chaotic and of lower magnitude. On the basis of the above analysis, a second, more subtle, division line may extend from 1280E 1880N to 1600E 2180N. As noted for the eastern portion of the site, the area west of this dividing line may also indicate a reduction of buried ferrous material.

A combined interpretation of the total field and vertical gradient results would suggest that the content of ferrous metal in the fill material varies. West of approximately 17[illegible]E the surface material contains small randomly located pieces of ferrous material. Whereas, east of this line, ferrous material is apparently deeper or absent.

In addition to the broad site characterization, several more subtle geophysical features are visible in Figures 3, 4, 5, and 7. In these figures, a trend is evident from 1950E 1880N towards 2110E 2050N. The source of this anomaly is unknown but appears to be constructed of higher conductivity soils and varying amounts of metal, including ferrous material. As mentioned in the results, the small strip surveyed north of Marina Drive and possibly including the roadway may be constructed of material different then what composes the fill south of Marina Drive. The 40 foot wide zone from approximately 1130E to 1350E along 1980 is a relatively low conductivity zone with little indications of buried metal. As previously mentioned, the validity of the data is highly compromised by the presence of boats and parked trailers, which are nearly delineated by the red contour lines in Figure 5. However, interpreting the data near 1180E 1980N may suggest the fill material is different from the center portion of the site. The conductivities are much lower then the central region and slightly lower than the areas delineated by the black contour lines along the eastern side of the site. This may imply a change in fill material or a reemergence of the type of fill techniques used east of 1730N.

The geophysical results provide a basis for the design of a future sampling program. Auger holes at approximately 1970E 2000N, in the low conductivity zone, and at approximately 1650E 2080N, in the high conductivity zone, would offer insight to the sources that lead to the differences in apparent conductivity across the site. The parameters controlling these variations could then be projected to the remaining portions of the area.

QUALITY CONTROL

The quality of the electromagnetic data was ensured through extreme care during the field measurements and by repeated measurements at a calibration station established at 1520E 2120N. The operator of the EM31 conductivity meter obtained all measurements with the long axis of the instrument aligned parallel to the X-axis. The instrument was returned to the calibration station approximately every hour during acquisition. The EM31 measurements at the calibration station maintained an apparent conductivity of 32 millimhos/meter and varied by less than .5 millimhos per meter. The inphase response maintained a constant 1 ppt. The sensitivity, phase, and power levels were within the manufactures' recommendations.

A magnetic base station was located at 1700E 2000N. The magnetic variations at the base station were less than 50 gammas during any one hour period and less than 100 gammas throughout the duration of the survey. Three measurements were recorded each time a base measurement was obtained. These three measurements varied by less than 5 gammas.

This is the best indication that the magnetometer operated consistently throughout the survey. The maximum variation of 100 gammas is an indication of the magnetic field's stability in this region, during the survey. This relatively small variation implies that the temporal variations would not likely be a source of field fluctuations that could create mappable anomalies.

STANDARD DISCLAIMER

The objective of any geophysical survey is to define the existence and configuration of features at depth. However, these features may bear a highly complex relationship to the geophysical measurements recorded. Therefore, conclusions drawn, no matter how logically deduced, should not be misconstrued as fact. We shall not and will not, except in the case of gross or willful negligence on our part, be liable or responsible for any losses, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, employees and agents or by anyone else not related to Fromm Applied Technology who might base interpretations and opinions on our geophysical surveys.

Geophysical Figures

NOTE:
Appendix D: Marina Drive Site -- EM31 Data and
Appendix E: Marina Drive Site -- Magnetic Data
are not included in this SEH Report

ENVIROSCAN

July 25, 1994

Short Elliott Hendrickson, Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

Attn: Cyrus W. Ingraham

Re: Analytical Results
#WIDNR9401

Please find enclosed the analytical results for the samples received June 30, 1994. All analyses were done in accordance with EPA Methods (EPA-600/4-79-020, March, 1983 or SW-846, Third Edition).

The chain of custody document is enclosed.

If you have any questions about the results, please call. Thank you for using Enviroscan Corp. for your analytical needs.

Sincerely,

Enviroscan Corp.

Bruce M. Schertz

Bruce M. Schertz
Inorganic Laboratory Supervisor

303 West Military Road Rothschild, WI 54474 (715) 359-7226
An Affiliate of the Black Clawson Co

ANALYTICAL REPORT

Short Elliott Hendrickson, Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

Attn: Cyrus W. Ingraham

CUST NUMBER: WIDNR9401
SAMPLED BY: Client
DATE REC'D: 06/30/94
REPORT DATE: 07/25/94
PREPARED BY: BMS
REVIEWED BY:

	Units	Detection Limit	AW-1 06/28/94	Qualifiers	Date Analyzed
EPA 200.7					
Aluminum	mg/l	0.031	0.061		07/21/94
Iron	mg/l	0.010	X		07/18/94
EPA 206.2					
Arsenic (GFAAS)	mg/l	0.0011	0.0021		07/25/94
EPA 335.1					
Cyanide, amenable	mg/l	0.01	X		07/07/94
EPA 415.2					
Nonpurge Org. Carbon	mg/l	0.6	X		07/20/94
EPA 335.3					
Cyanide	mg/l	0.01	X		07/07/94
EPA 8021					
Benzene	µg/l	0.2	X		07/02/94
Bromobenzene	µg/l	0.5	X		07/02/94
Bromochloromethane	µg/l	1.0	X		07/02/94
Bromodichloromethane	µg/l	0.5	X		07/02/94
Bromoform	µg/l	2.0	X		07/02/94
Bromomethane	µg/l	4.0	X		07/02/94
n-Butylbenzene	µg/l	1.0	X		07/02/94
sec-Butylbenzene	µg/l	1.0	X		07/02/94
tert-Butylbenzene	µg/l	1.0	X		07/02/94
Carbon Tetrachloride	µg/l	0.5	X		07/02/94
Chlorobenzene	µg/l	2.0	X		07/02/94
Chlorodibromomethane	µg/l	0.5	X		07/02/94
Chloroethane	µg/l	2.0	X		07/02/94
Chloroform	µg/l	0.5	X		07/02/94
Chloromethane	µg/l	2.0	X		07/02/94
o-Chlorotoluene	µg/l	1.0	X		07/02/94
p-Chlorotoluene	µg/l	1.0	X		07/02/94
Analytical No.:			14612		

X = Analyzed but not detected.

All analyses conducted in accordance with Enviroscan Quality Assurance Program.

ANALYTICAL REPORT

Short Elliott Hendrickson, Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

CUST NUMBER: WIDNR9401
SAMPLED BY: Client
DATE REC'D: 06/30/94
REPORT DATE: 07/25/94
PREPARED BY: BMS
REVIEWED BY:

Attn: Cyrus W. Ingraham

	Units	Detection Limit	AW-1 06/28/94	Qualifiers	Date Analyzed
1,2-Dibromo-3-chloropropane	µg/l	13.3	X		07/02/94
1,2-Dibromoethane	µg/l	1.0	X		07/02/94
Dibromomethane	µg/l	0.5	X		07/02/94
1,2-Dichlorobenzene	µg/l	1.0	X		07/02/94
1,3-Dichlorobenzene	µg/l	1.0	X		07/02/94
1,4-Dichlorobenzene	µg/l	0.5	X		07/02/94
Dichlorodifluoromethane	µg/l	2.0	X		07/02/94
1,1-Dichloroethane	µg/l	0.5	X		07/02/94
1,2-Dichloroethane	µg/l	0.5	X		07/02/94
1,1-Dichloroethylene	µg/l	0.4	X		07/02/94
cis-1,2-Dichloroethylene	µg/l	0.5	X		07/02/94
trans-1,2-Dichloroethylene	µg/l	0.5	X		07/02/94
1,2-Dichloropropane	µg/l	0.5	X		07/02/94
1,3-Dichloropropane	µg/l	0.5	X		07/02/94
2,2-Dichloropropane	µg/l	2.0	X		07/02/94
1,1-Dichloropropene	µg/l	1.0	X		07/02/94
1,3-Dichloropropene	µg/l	0.5	X		07/02/94
Ethylbenzene	µg/l	1.0	X		07/02/94
Hexachlorobutadiene	µg/l	1.0	X		07/02/94
Isopropylbenzene	µg/l	1.0	X		07/02/94
p-Isopropyltoluene	µg/l	1.0	X		07/02/94
Methyl tert Butyl Ether	µg/l	2.0	X		07/02/94
Methylene Chloride	µg/l	2.5	X		07/02/94
Naphthalene	µg/l	1.0	X		07/02/94
n-Propylbenzene	µg/l	1.0	X		07/02/94
Styrene	µg/l	5.0	X		07/02/94
Tetrachloroethylene	µg/l	0.5	X		07/02/94
1,1,1,2-Tetrachloroethane	µg/l	0.5	X		07/02/94
1,1,2,2-Tetrachloroethane	µg/l	1.0	X		07/02/94
Toluene	µg/l	2.0	X		07/02/94
1,2,3-Trichlorobenzene	µg/l	1.0	X		07/02/94
1,2,4-Trichlorobenzene	µg/l	1.0	X		07/02/94
1,1,1-Trichloroethane	µg/l	0.5	X		07/02/94
1,1,2-Trichloroethane	µg/l	0.5	X		07/02/94
Trichloroethylene	µg/l	0.2	X		07/02/94
Trichlorofluoromethane	µg/l	1.0	X		07/02/94
1,2,3-Trichloropropane	µg/l	2.0	X		07/02/94
1,2,4-Trimethylbenzene	µg/l	1.0	X		07/02/94
1,3,5-Trimethylbenzene	µg/l	1.0	X		07/02/94
Vinyl Chloride	µg/l	0.2	X		07/02/94
m- & p-Xylene	µg/l	1.0	X		07/02/94
o-Xylene	µg/l	1.0	X		07/02/94
Analytical No.:			14612		

"X" = Analyzed but not detected.

All analyses conducted in accordance with Enviroscan Quality Assurance Program.

ANALYTICAL REPORT

Short Elliott Hendrickson, Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

CUST NUMBER: WIDNR9401
SAMPLED BY: Client
DATE REC'D: 06/30/94
REPORT DATE: 07/25/94
PREPARED BY: BMS
REVIEWED BY:

Attn: Cyrus W. Ingraham

	Units	Detection Limit	AW-1 06/28/94	Qualifiers	Date Analyzed
EPA 8310					
Acenaphthene	µg/l	0.1	X		07/07/94
Acenaphthylene	µg/l	0.4	X		07/07/94
Anthracene	µg/l	0.08	X		07/07/94
Benzo(a)Anthracene	µg/l	0.04	X		07/07/94
Benzo(a)Pyrene	µg/l	0.06	X		07/07/94
Benzo(b)Fluoranthene	µg/l	0.03	X		07/07/94
Benzo(k)Fluoranthene	µg/l	0.08	X		07/07/94
Benzo(ghi)Perylene	µg/l	0.1	[illegible]		[illegible]/07/94
Chrysene	µg/l	0.1	X		07/07/94
Dibenzo(a,h)Anthracene	µg/l	0.11	X		07/07/94
Fluoranthene	µg/l	0.22	X		07/07/94
Fluorene	µg/l	0.06	X		07/07/94
Indeno(1,2,3-cd)Pyrene	µg/l	0.1	X		07/07/94
1-Methyl Naphthalene	µg/l	0.4	X		07/07/94
2-Methyl Naphthalene	µg/l	0.4	X		07/07/94
Naphthalene	µg/l	0.11	X		07/07/94
Phenanthrene	µg/l	0.05	X		07/07/94
Pyrene	µg/l	0.1	X		07/07/94
Extraction Date					07/01/94

Analytical No.: 14612

X = Analyzed but not detected.

ANALYTICAL REPORT

Short Elliott Hendrickson, Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

Attn: Cyrus W. Ingraham

CUST NUMBER: WIDNR9401
SAMPLED BY: Client
DATE REC'D: 06/30/94
REPORT DATE: 07/25/94
PREPARED BY: BMS
REVIEWED BY:

	Units	Detection Limit	MW-3 06/28/94	Qualifiers	Date Analyzed
EPA 200.7					
Aluminum	mg/l	0.031	0.037		07/21/94
Iron	mg/l	0.010	0.959		07/18/94
EPA 206.2					
Arsenic (GFAAS)	mg/l	0.0011	X		07/25/94
EPA 335.1					
Cyanide, amenable	mg/l	0.01	X		07/07/94
EPA 415.2					
Nonpurge Org. Carbon	mg/l	0.6	12.3		07/20/94
EPA 335.3					
Cyanide	mg/l	0.01	X		07/07/94
EPA 8021					
Benzene	µg/l	0.2	0.8		07/05/94
Bromobenzene	µg/l	0.5	X		07/05/94
Bromochloromethane	µg/l	1.0	X		07/05/94
Bromodichloromethane	µg/l	0.5	X		07/05/94
Bromoform	µg/l	2.0	X		07/05/94
Bromomethane	µg/l	4.0	X		07/05/94
n-Butylbenzene	µg/l	1.0	X		07/05/94
sec-Butylbenzene	µg/l	1.0	X		07/05/94
tert-Butylbenzene	µg/l	1.0	X		07/05/94
Carbon Tetrachloride	µg/l	0.5	X		07/05/94
Chlorobenzene	µg/l	2.0	X		07/05/94
Chlorodibromomethane	µg/l	0.5	X		07/05/94
Chloroethane	µg/l	2.0	X		07/05/94
Chloroform	µg/l	0.5	X		07/05/94
Chloromethane	µg/l	2.0	X		07/05/94
o-Chlorotoluene	µg/l	1.0	X		07/05/94
p-Chlorotoluene	µg/l	1.0	X		07/05/94
Analytical No.:			14613		

X = Analyzed but not detected.

ANALYTICAL REPORT

Short Elliott Hendrickson, Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

CUST NUMBER: WIDNR9401
SAMPLED BY: Client
DATE REC'D: 06/30/94
REPORT DATE: 07/25/94
PREPARED BY: BMS
REVIEWED BY:

Attn: Cyrus W. Ingraham

	Units	Detection Limit	MW-3 DUPLICATE 06/28/94	Qualifiers	Date Analyzed
Methyl tert Butyl Ether	µg/l	2.0	X		07/05/94
Methylene Chloride	µg/l	2.5	X		07/05/94
Naphthalene	µg/l	1.0	X		07/05/94
n-Propylbenzene	µg/l	1.0	X		07/05/94
Styrene	µg/l	5.0	X		07/05/94
Tetrachloroethylene	µg/l	0.5	X		07/05/94
1,1,1,2-Tetrachloroethane	µg/l	0.5	X		07/05/94
1,1,2,2-Tetrachloroethane	µg/l	1.0	X		07/05/94
Toluene	µg/l	2.0	X		07/05/94
1,2,3-Trichlorobenzene	µg/l	1.0	X		07/05/94
1,2,4-Trichlorobenzene	µg/l	1.0	X		07/05/94
1,1,1-Trichloroethane	µg/l	0.5	X		07/05/94
1,1,2-Trichloroethane	µg/l	0.5	X		07/05/94
Trichloroethylene	µg/l	0.2	X		07/05/94
Trichlorofluoromethane	µg/l	1.0	X		07/05/94
1,2,3-Trichloropropane	µg/l	2.0	X		07/05/94
1,2,4-Trimethylbenzene	µg/l	1.0	X		07/05/94
1,3,5-Trimethylbenzene	µg/l	1.0	X		07/05/94
Vinyl Chloride	µg/l	0.2	X		07/05/94
m- & p-Xylene	µg/l	1.0	X		07/05/94
o-Xylene	µg/l	1.0	X		07/05/94
Analytical No.:			14614		

X = Analyzed but not detected.

All analyses conducted in accordance with Enviroscan Quality Assurance Program.

ANALYTICAL REPORT

Short Elliott Hendrickson, Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

CUST NUMBER: WIDNR9401
SAMPLED BY: Client
DATE REC'D: 06/30/94
REPORT DATE: 07/25/94
PREPARED BY: BMS
REVIEWED BY:

Attn: Cyrus W. Ingraham

	Units	Detection Limit	MW-1 06/28/94	Qualifiers	Date Analyzed
EPA 200.7					
Aluminum	mg/l	0.031	0.066		07/21/94
Iron	mg/l	0.010	1.21		07/18/94
EPA 206.2					
Arsenic (GFAAS)	mg/l	0.0011	X		07/25/94
EPA 335.1					
Cyanide, amenable	mg/l	0.01	X		07/07/94
EPA 415.2					
Nonpurge Org. Carbon	mg/l	0.6	8.28		07/20/94
EPA 335.3					
Cyanide	mg/l	0.01	X		07/07/94
EPA 8021					
Benzene	µg/l	100.0	4,240.		07/02/94
Bromobenzene	µg/l	25.0	X		07/06/94
Bromochloromethane	µg/l	50.0	X		07/06/94
Bromodichloromethane	µg/l	25.0	X		07/06/94
Bromoform	µg/l	100.0	X		07/06/94
Bromomethane	µg/l	200.0	X		07/06/94
n-Butylbenzene	µg/l	50.0	X		07/06/94
sec-Butylbenzene	µg/l	50.0	X		07/06/94
tert-Butylbenzene	µg/l	50.0	X		07/06/94
Carbon Tetrachloride	µg/l	25.0	X		07/06/94
Chlorobenzene	µg/l	100.0	X		07/06/94
Chlorodibromomethane	µg/l	25.0	X		07/06/94
Chloroethane	µg/l	100.0	X		07/06/94
Chloroform	µg/l	25.0	X		07/06/94
Chloromethane	µg/l	100.0	X		07/06/94
o-Chlorotoluene	µg/l	50.0	X		07/06/94
p-Chlorotoluene	µg/l	50.0	X		07/06/94
Analytical No.:			14615		

X = Analyzed but not detected.

ll analyses conducted in accordance with Enviroscan Quality Assurance Program.

ANALYTICAL REPORT

Short Elliott Hendrickson, Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

CUST NUMBER: WIDNR9401
SAMPLED BY: Client
DATE REC'D: 06/30/94
REPORT DATE: 07/25/94
PREPARED BY: BMS BM
REVIEWED BY: JW

Attn: Cyrus W. Ingraham

	Units	Detection Limit	MW-3 DUPLICATE 06/28/94	Qualifiers	Date Analyzed
EPA 8021					
Benzene	μg/l	0.2	0.8		07/05/94
Bromobenzene	μg/l	0.5	X		07/05/94
Bromochloromethane	μg/l	1.0	X		07/05/94
Bromodichloromethane	μg/l	0.5	X		07/05/94
Bromoform	μg/l	2.0	X		07/05/94
Bromomethane	μg/l	4.0	X		07/05/94
n-Butylbenzene	μg/l	1.0	X		07/05/94
sec-Butylbenzene	μg/l	1.0	X		07/05/94
tert-Butylbenzene	μg/l	1.0	X		07/05/94
Carbon Tetrachloride	μg/l	0.5	X		07/05/94
Chlorobenzene	μg/l	2.0	X		07/05/94
Chlorodibromomethane	μg/l	0.5	X		07/05/94
Chloroethane	μg/l	2.0	X		07/05/94
Chloroform	μg/l	0.5	X		07/05/94
Chloromethane	μg/l	2.0	X		07/05/94
o-Chlorotoluene	μg/l	1.0	X		07/05/94
p-Chlorotoluene	μg/l	1.0	X		07/05/94
1,2-Dibromo-3-chloropropane	μg/l	13.3	X		07/05/94
1,2-Dibromoethane	μg/l	1.0	X		07/05/94
Dibromomethane	μg/l	0.5	X		07/05/94
1,2-Dichlorobenzene	μg/l	1.0	X		07/05/94
1,3-Dichlorobenzene	μg/l	1.0	X		07/05/94
1,4-Dichlorobenzene	μg/l	0.5	X		07/05/94
Dichlorodifluoromethane	μg/l	2.0	X		07/05/94
1,1-Dichloroethane	μg/l	0.5	X		07/05/94
1,2-Dichloroethane	μg/l	0.5	X		07/05/94
1,1-Dichloroethylene	μg/l	0.4	X		07/05/94
cis-1,2-Dichloroethylene	μg/l	0.5	X		07/05/94
trans-1,2-Dichloroethylene	μg/l	0.5	X		07/05/94
1,2-Dichloropropane	μg/l	0.5	X		07/05/94
1,3-Dichloropropane	μg/l	0.5	X		07/05/94
2,2-Dichloropropane	μg/l	2.0	X		07/05/94
1,1-Dichloropropene	μg/l	1.0	X		07/05/94
1,3-Dichloropropene	μg/l	0.5	X		07/05/94
Ethylbenzene	μg/l	1.0	X		07/05/94
Hexachlorobutadiene	μg/l	1.0	X		07/05/94
Isopropylbenzene	μg/l	1.0	X		07/05/94
p-Isopropyltoluene	μg/l	1.0	X		07/05/94
Analytical No.:			14614		

X = Analyzed but not detected.

All analyses conducted in accordance with Enviroscan Quality Assurance Program.

.NALYTICAL REPORT

Short Elliott Hendrickson, Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

CUST NUMBER: WIDNR9401
SAMPLED BY: Client
DATE REC'D: 06/30/94
REPORT DATE: 07/25/94
PREPARED BY: BMS BMS
REVIEWED BY: HB

Attn: Cyrus W. Ingraham

	Units	Detection Limit	MW-3 06/28/94	Qualifiers	Date Analyzed
EPA 8310					
Acenaphthene	µg/l	0.1	11.9		07/07/94
Acenaphthylene	µg/l	0.4	X		07/07/94
Anthracene	µg/l	0.08	39.0		07/07/94
Benzo(a)Anthracene	µg/l	0.04	56.4		07/07/94
Benzo(a)Pyrene	µg/l	0.06	69.3		07/07/94
Benzo(b)Fluoranthene	µg/l	0.03	28.1		07/07/94
Benzo(k)Fluoranthene	µg/l	0.08	19.8		07/07/94
Benzo(ghi)Perylene	µg/l	0.1	X		07/07/94
Chrysene	µg/l	0.1	X		07/07/94
Dibenzo(a,h)Anthracene	µg/l	0.11	X		07/07/94
Fluoranthene	µg/l	0.22	210.		07/07/94
Fluorene	µg/l	0.06	6.29		07/07/94
Indeno(1,2,3-cd)Pyrene	µg/l	0.1	X		07/07/94
1-Methyl Naphthalene	µg/l	0.4	X		07/07/94
:-Methyl Naphthalene	µg/l	0.4	X		07/07/94
Naphthalene	µg/l	0.11	X		07/07/94
Phenanthrene	µg/l	0.05	19.2		07/07/94
Pyrene	µg/l	0.1	317.		07/07/94
Extraction Date					07/01/94
Analytical No.:			14613		

X = Analyzed but not detected.

ll analyses conducted in accordance with Enviroscan Quality Assurance Program.

ANALYTICAL REPORT

Short Elliott Hendrickson, Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

CUST NUMBER: WIDNR9401
SAMPLED BY: Client
DATE REC'D: 06/30/94
REPORT DATE: 07/25/94
PREPARED BY: BMS
REVIEWED BY:

Attn: Cyrus W. Ingraham

	Units	Detection Limit	MW-3 06/28/94	Qualifiers	Date Analyzed
1,2-Dibromo-3-chloropropane	µg/l	13.3	X		07/05/94
1,2-Dibromoethane	µg/l	1.0	X		07/05/94
Dibromomethane	µg/l	0.5	X		07/05/94
1,2-Dichlorobenzene	µg/l	1.0	X		07/05/94
1,3-Dichlorobenzene	µg/l	1.0	X		07/05/94
1,4-Dichlorobenzene	µg/l	0.5	X		07/05/94
Dichlorodifluoromethane	µg/l	2.0	X		07/05/94
1,1-Dichloroethane	µg/l	0.5	X		07/05/94
1,2-Dichloroethane	µg/l	0.5	X		07/05/94
1 1-Dichloroethyl .ne	µg/l	0.4	X		07/05/94
cis-1,2-Dichloroethylene	µg/l	0.5	X		07/05/94
trans-1,2-Dichloroethylene	µg/l	0.5	X		07/05/94
1,2-Dichloropropane	µg/l	0.5	X		07/05/94
1,3-Dichloropropane	µg/l	0.5	X		07/05/94
2,2-Dichloropropane	µg/l	2.0	X		07/05/94
1,1-Dichloropropene	µg/l	1.0	X		07/05/94
1,3-Dichloropropene	µg/l	0.5	X		07/05/94
Ethylbenzene	µg/l	1.0	X		07/05/94
Hexachlorobutadiene	µg/l	1.0	X		07/05/94
Isopropylbenzene	µg/l	1.0	X		07/05/94
p-Isopropyltoluene	µg/l	1.0	X		07/05/94
Methyl tert Butyl Ether	µg/l	2.0	X		07/05/94
Methylene Chloride	µg/l	2.5	X		07/05/94
Naphthalene	µg/l	1.0	X		07/05/94
n-Propylbenzene	µg/l	1.0	X		07/05/94
Styrene	µg/l	5.0	X		07/05/94
Tetrachloroethylene	µg/l	0.5	X		07/05/94
1,1,1,2-Tetrachloroethane	µg/l	0.5	X		07/05/94
1,1,2,2-Tetrachloroethane	µg/l	1.0	X		07/05/94
Toluene	µg/l	2.0	X		07/05/94
1,2,3-Trichlorobenzene	µg/l	1.0	X		07/05/94
1,2,4-Trichlorobenzene	µg/l	1.0	X		07/05/94
1,1,1-Trichloroethane	µg/l	0.5	X		07/05/94
1,1,2-Trichloroethane	µg/l	0.5	X		07/05/94
Trichloroethylene	µg/l	0.2	X		07/05/94
Trichlorofluoromethane	µg/l	1.0	X		07/05/94
1,2,3-Trichloropropane	µg/l	2.0	X		07/05/94
1,2,4-Trimethylbenzene	µg/l	1.0	X		07/05/94
1,3,5-Trimethylbenzene	µg/l	1.0	X		07/05/94
Vinyl Chloride	µg/l	0.2	X		07/05/94
m- & p-Xylene	µg/l	1.0	X		07/05/94
o-Xylene & Styrene	µg/l	1.0	X		07/05/94
Analytical No.:			14613		

' = Analyzed but not detected.

ll analyses conducted in accordance with Enviroscan Quality Assurance Program.

ANALYTICAL REPORT

Short Elliott Hendrickson, Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

CUST NUMBER: WIDNR9401
SAMPLED BY: Client
DATE REC'D: 06/30/94
REPORT DATE: 07/25/94
PREPARED BY: BMS
REVIEWED BY:

Attn: Cyrus W. Ingraham

	Units	Detection Limit	MW-1 06/28/94	Qualifiers	Date Analyzed
1,2-Dibromo-3-chloropropane	µg/l	665.0	X		07/06/94
1,2-Dibromoethane	µg/l	50.0	X		07/06/94
Dibromomethane	µg/l	25.0	X		07/06/94
1,2-Dichlorobenzene	µg/l	50.0	X		07/06/94
1,3-Dichlorobenzene	µg/l	50.0	X		07/06/94
1,4-Dichlorobenzene	µg/l	25.0	X		07/06/94
Dichlorodifluoromethane	µg/l	100.0	X		07/06/94
1,1-Dichloroethane	µg/l	25.0	X		07/06/94
1,2-Dichloroethane	µg/l	25.0	X		07/06/94
1,1-Dichloroethylene	µg/l	20.0	X		0 06/94
cis-1,2-Dichloroethylene	µg/l	25.0	X		07/06/94
trans-1,2-Dichloroethylene	µg/l	25.0	X		07/06/94
1,2-Dichloropropane	µg/l	25.0	X		07/06/94
1,3-Dichloropropane	µg/l	25.0	X		07/06/94
2,2-Dichloropropane	µg/l	100.0	X		07/06/94
1,1-Dichloropropene	µg/l	50.0	X		07/06/94
1,3-Dichloropropene	µg/l	25.0	X		07/06/94
Ethylbenzene	µg/l	50.0	413.		07/06/94
Hexachlorobutadiene	µg/l	50.0	X		07/06/94
Isopropylbenzene	µg/l	50.0	X		07/06/94
p-Isopropyltoluene	µg/l	50.0	X		07/06/94
Methyl tert Butyl Ether	µg/l	100.0	X		07/06/94
Methylene Chloride	µg/l	125.0	X		07/06/94
Naphthalene	µg/l	500.0	1,490.		07/02/94
n-Propylbenzene	µg/l	50.0	X		07/06/94
Styrene	µg/l	250.0	X		07/06/94
Tetrachloroethylene	µg/l	25.0	X		07/06/94
1,1,1,2-Tetrachloroethane	µg/l	25.0	X		07/06/94
1,1,2,2-Tetrachloroethane	µg/l	50.0	X		07/06/94
Toluene	µg/l	100.0	651.		07/06/94
1,2,3-Trichlorobenzene	µg/l	50.0	X		07/06/94
1,2,4-Trichlorobenzene	µg/l	50.0	X		07/06/94
1,1,1-Trichloroethane	µg/l	25.0	X		07/06/94
1,1,2-Trichloroethane	µg/l	25.0	X		07/06/94
Trichloroethylene	µg/l	10.0	X		07/06/94
Trichlorofluoromethane	µg/l	50.0	X		07/06/94
1,2,3-Trichloropropane	µg/l	100.0	X		07/06/94
1,2,4-Trimethylbenzene	µg/l	50.0	107.		07/06/94
1,3,5-Trimethylbenzene	µg/l	50.0	X		07/06/94
Vinyl Chloride	µg/l	10.0	X		07/06/94
m- & p-Xylene	µg/l	50.0	225.		07/06/94
o-Xylene & Styrene	µg/l	50.0	224.		07/06/94

Analytical No.: 14615

X = Analyzed but not detected.

ANALYTICAL REPORT

Short Elliott Hendrickson, Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

CUST NUMBER: WIDNR9401
SAMPLED BY: Client
DATE REC'D: 06/30/94
REPORT DATE: 07/25/94
PREPARED BY: BMS
REVIEWED BY:

Attn: Cyrus W. Ingraham

	Units	Detection Limit	MW-1 06/28/94	Qualifiers	Date Analyzed
EPA 8310					
Acenaphthene	µg/l	0.1	253.		07/07/94
Acenaphthylene	µg/l	0.4	465.		07/07/94
Anthracene	µg/l	0.08	9.35		07/07/94
Benzo(a)Anthracene	µg/l	0.04	0.473		07/07/94
Benzo(a)Pyrene	µg/l	0.06	0.539		07/07/94
Benzo(b)Fluoranthene	µg/l	0.03	X		07/07/94
Benzo(k)Fluoranthene	µg/l	0.08	X		07/07/94
Benzo(ghi)Perylene	µg/l	0.1	X		07/07/94
Chrysene	µg/l	0.1	X		07/07/94
Dibenzo(a,h)Anthracene	µg/l	0.11	X		07/07/94
Fluoranthene	µg/l	0.22	X		07/07/94
Fluorene	µg/l	0.06	51.3		07/07/94
Indeno(1,2,3-cd)Pyrene	µg/l	0.1	X		07/07/94
1-Methyl Naphthalene	µg/l	0.4	575.		07/07/94
-Methyl Naphthalene	µg/l	0.4	344.		07/07/94
Naphthalene	µg/l	0.11	702.		07/07/94
Phenanthrene	µg/l	0.05	53.2		07/07/94
Pyrene	µg/l	0.1	X		07/07/94
Extraction Date					07/01/94

Analytical No.: 14615

X = Analyzed but not detected.

All analyses conducted in accordance with Enviroscan Quality Assurance Program.

ANALYTICAL REPORT

Short Elliott Hendrickson, Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

Attn: Cyrus W. Ingraham

CUST NUMBER: WIDNR9401
SAMPLED BY: Client
DATE REC'D: 06/30/94
REPORT DATE: 07/25/94
PREPARED BY: BMS
REVIEWED BY:

	Units	Detection Limit	MW-2 06/28/94	Qualifiers	Date Analyzed
EPA 200.7					
Aluminum	mg/l	0.031	0.066		07/21/94
Iron	mg/l	0.010	3.65		07/18/94
EPA 206.2					
Arsenic (GFAAS)	mg/l	0.0011	0.0014		07/25/94
EPA 335.1					
Cyanide, amenable	mg/l	0.01	X		07/07/94
EPA 415.2					
Nonpurge Org. Carbon	mg/l	0.6	10.2		07/20/94
EPA 335.3					
Cyanide	mg/l	0.01	0.012		07/07/94
EPA 8021					
Benzene	µg/l	20.0	1,090.	S1H S2H	07/02/94
Bromobenzene	µg/l	50.0	X		07/02/94
Bromochloromethane	µg/l	100.0	X		07/02/94
Bromodichloromethane	µg/l	50.0	X		07/02/94
Bromoform	µg/l	200.0	X		07/02/94
Bromomethane	µg/l	400.0	X		07/02/94
n-Butylbenzene	µg/l	100.0	X		07/02/94
sec-Butylbenzene	µg/l	100.0	X		07/02/94
tert-Butylbenzene	µg/l	100.0	X		07/02/94
Carbon Tetrachloride	µg/l	50.0	X		07/02/94
Chlorobenzene	µg/l	200.0	X		07/02/94
Chlorodibromomethane	µg/l	50.0	X		07/02/94
Chloroethane	µg/l	200.0	X		07/02/94
Chloroform	µg/l	50.0	X		07/02/94
Chloromethane	µg/l	200.0	X		07/02/94
o-Chlorotoluene	µg/l	100.0	X		07/02/94
p-Chlorotoluene	µg/l	100.0	X		07/02/94
Analytical No.:			14616		

X = Analyzed but not detected.

ANALYTICAL REPORT

Short Elliott Hendrickson, Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

CUST NUMBER: WIDNR9401
SAMPLED BY: Client
DATE REC'D: 06/30/94
REPORT DATE: 07/25/94
PREPARED BY: BMS
REVIEWED BY:

Attn: Cyrus W. Ingraham

	Units	Detection Limit	MW-2 06/28/94	Qualifiers	Date Analyzed
1,2-Dibromo-3-chloropropane	µg/l	1330.0	X		07/02/94
1,2-Dibromoethane	µg/l	100.0	X		07/02/94
Dibromomethane	µg/l	50.0	X		07/02/94
1,2-Dichlorobenzene	µg/l	100.0	X		07/02/94
1,3-Dichlorobenzene	µg/l	100.0	X		07/02/94
1,4-Dichlorobenzene	µg/l	50.0	X		07/02/94
Dichlorodifluoromethane	µg/l	200.0	X		07/02/94
1,1-Dichloroethane	µg/l	50.0	X		07/02/94
1,2-Dichloroethane	µg/l	50.0	X		07/02/94
1,1-Dichloroethylene	µg/l	40.0	X		07/02/94
cis-1,2-Dichloroethylene	µg/l	50.0	X		07/02/94
trans-1,2-Dichloroethylene	µg/l	50.0	X		07/02/94
1,2-Dichloropropane	µg/l	50.0	X		07/02/94
1,3-Dichloropropane	µg/l	50.0	X		07/02/94
2,2-Dichloropropane	µg/l	200.0	X		07/02/94
1,1-Dichloropropene	µg/l	100.0	X		07/02/94
1,3-Dichloropropene	µg/l	50.0	X		07/02/94
Ethylbenzene	µg/l	100.0	113.		07/02/94
Hexachlorobutadiene	µg/l	100.0	X		07/02/94
Isopropylbenzene	µg/l	100.0	X		07/02/94
p-Isopropyltoluene	µg/l	100.0	X		07/02/94
Methyl tert Butyl Ether	µg/l	200.0	X		07/02/94
Methylene Chloride	µg/l	250.0	X		07/02/94
Naphthalene	µg/l	100.0	607.		07/02/94
n-Propylbenzene	µg/l	100.0	X		07/02/94
Styrene	µg/l	500.0	X		07/02/94
Tetrachloroethylene	µg/l	50.0	X		07/02/94
1,1,1,2-Tetrachloroethane	µg/l	50.0	X		07/02/94
1,1,2,2-Tetrachloroethane	µg/l	100.0	X		07/02/94
Toluene	µg/l	200.0	X		07/02/94
1,2,3-Trichlorobenzene	µg/l	100.0	X		07/02/94
1,2,4-Trichlorobenzene	µg/l	100.0	X		07/02/94
1,1,1-Trichloroethane	µg/l	50.0	X		07/02/94
1,1,2-Trichloroethane	µg/l	50.0	X		07/02/94
Trichloroethylene	µg/l	20.0	X		07/02/94
Trichlorofluoromethane	µg/l	100.0	X	DUP	07/02/94
1,2,3-Trichloropropane	µg/l	200.0	X		07/02/94
1,2,4-Trimethylbenzene	µg/l	100.0	X		07/02/94
1,3,5-Trimethylbenzene	µg/l	100.0	X		07/02/94
Vinyl Chloride	µg/l	20.0	X		07/02/94
m- & p-Xylene	µg/l	100.0	X		07/02/94
o-Xylene	µg/l	100.0	X		07/02/94
Analytical No.:			14616		

= Analyzed but not detected.

ll analyses conducted in accordance with Enviroscan Quality Assurance Program.

ANALYTICAL REPORT

Short Elliott Hendrickson, Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

CUST NUMBER: WIDNR9401
SAMPLED BY: Client
DATE REC'D: 06/30/94
REPORT DATE: 07/25/94
PREPARED BY: BMS
REVIEWED BY:

Attn: Cyrus W. Ingraham

	Units	Detection Limit	MW-2 06/28/94	Qualifiers	Date Analyzed
EPA 8310					
Acenaphthene	µg/l	0.1	42.8		07/07/94
Acenaphthylene	µg/l	0.4	98.5		07/07/94
Anthracene	µg/l	0.08	1.60		07/07/94
Benzo(a)Anthracene	µg/l	0.04	0.522		07/07/94
Benzo(a)Pyrene	µg/l	0.06	0.691		07/07/94
Benzo(b)Fluoranthene	µg/l	0.03	0.387		07/07/94
Benzo(k)Fluoranthene	µg/l	0.08	X		07/07/94
Benzo(ghi)Perylene	µg/l	0.1	X		[illegible]/07/94
Chrysene	µg/l	0.1	X		07/07/94
Dibenzo(a,h)Anthracene	µg/l	0.11	X		07/07/94
Fluoranthene	µg/l	0.22	X		07/07/94
Fluorene	µg/l	0.06	4.05		07/07/94
Indeno(1,2,3-cd)Pyrene	µg/l	0.1	X		07/07/94
1-Methyl Naphthalene	µg/l	0.4	59.2		07/07/94
2-Methyl Naphthalene	µg/l	0.4	20.1		07/07/94
Naphthalene	µg/l	0.11	90.1		07/07/94
Phenanthrene	µg/l	0.05	X		07/07/94
Pyrene	µg/l	0.1	X		07/07/94
Extraction Date					07/01/94
Analytical No.:			14616		

X = Analyzed but not detected.

Qualifier Descriptions

S1H	Matrix spike recovery was high. Result for sample may also be biased high.
S2H	Matrix spike duplicate was high. Result for sample may also be biased high.
DUP	Result of duplicate analysis exceeds the limits for precision. Results for sample may also show a high degree of variability.

ANALYTICAL REPORT

Short Elliott Hendrickson,Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

CUST NUMBER: WIDNR9401
SAMPLED BY: Client
DATE REC'D: 06/30/94
REPORT DATE: 07/25/94
PREPARED BY: JCH
REVIEWED BY:

Attn: Cyrus W. Ingraham

	Units	Detection Limit	TRIP BLANK-SP 06/28/94	Qualifiers	Date Analyzed
EPA 8021					
Benzene	µg/l	0.2	X		07/02/94
Bromobenzene	µg/l	0.5	X		07/02/94
Bromochloromethane	µg/l	1.0	X		07/02/94
Bromodichloromethane	µg/l	0.5	X		07/02/94
Bromoform	µg/l	2.0	X		07/02/94
Bromomethane	µg/l	4.0	X		07/02/94
n-Butylbenzene	µg/l	1.0	X		07/02/94
sec-Butylbenzene	µg/l	1.0	X		07/02/94
ter .-Butylbenzene	µg/l	1.0	X		07/02/94
Carbon Tetrachloride	µg/l	0.5	X		07/02/94
Chlorobenzene	µg/l	2.0	X		07/02/94
Chlorodibromomethane	µg/l	0.5	X		07/02/94
Chloroethane	µg/l	2.0	X		07/02/94
Chloroform	µg/l	0.5	X		07/02/94
Chloromethane	µg/l	2.0	X		07/02/94
›-Chlorotoluene	µg/l	1.0	X		07/02/94
p-Chlorotoluene	µg/l	1.0	X		07/02/94
1,2-Dibromo-3-chloropropane	µg/l	13.3	X		07/02/94
1,2-Dibromoethane	µg/l	1.0	X		07/02/94
Dibromomethane	µg/l	0.5	X		07/02/94
1,2-Dichlorobenzene	µg/l	1.0	X		07/02/94
1,3-Dichlorobenzene	µg/l	1.0	X		07/02/94
1,4-Dichlorobenzene	µg/l	0.5	X		07/02/94
Dichlorodifluoromethane	µg/l	2.0	X		07/02/94
1,1-Dichloroethane	µg/l	0.5	X		07/02/94
1,2-Dichloroethane	µg/l	0.5	X		07/02/94
1,1-Dichloroethylene	µg/l	0.4	X		07/02/94
cis-1,2-Dichloroethylene	µg/l	0.5	X		07/02/94
trans-1,2-Dichloroethylene	µg/l	0.5	X		07/02/94
1,2-Dichloropropane	µg/l	0.5	X		07/02/94
1,3-Dichloropropane	µg/l	0.5	X		07/02/94
2,2-Dichloropropane	µg/l	2.0	X		07/02/94
1,1-Dichloropropene	µg/l	1.0	X		07/02/94
1,3-Dichloropropene	µg/l	0.5	X		07/02/94
Ethylbenzene	µg/l	1.0	X		07/02/94
Hexachlorobutadiene	µg/l	1.0	X		07/02/94
Isopropylbenzene	µg/l	1.0	X		07/02/94
p-Isopropyltoluene	µg/l	1.0	X		07/02/94
Analytical No.:			14617		

X = Analyzed but not detected.

ll analyses conducted in accordance with Enviroscan Quality Assurance Program.

ANALYTICAL REPORT

Short Elliott Hendrickson, Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

Attn: Cyrus W. Ingraham

CUST NUMBER: WIDNR9401
SAMPLED BY: Client
DATE REC'D: 06/30/94
REPORT DATE: 07/25/94
PREPARED BY: JCH
REVIEWED BY:

	Units	Detection Limit	TRIP BLANK-SP 06/28/94	Qualifiers	Date Analyzed
Methyl tert Butyl Ether	µg/l	2.0	X		07/02/94
Methylene Chloride	µg/l	2.5	X		07/02/94
Naphthalene	µg/l	1.0	X		07/02/94
n-Propylbenzene	µg/l	1.0	X		07/02/94
Styrene	µg/l	5.0	X		07/02/94
Tetrachloroethylene	µg/l	0.5	X		07/02/94
1,1,1,2-Tetrachloroethane	µg/l	0.5	X		07/02/94
1,1,2,2-Tetrachloroethane	µg/l	1.0	X		07/02/94
Toluene	µg/l	2.0	X		07/02/94
1,2,3-Trichlorobenzene	µg/l	1.0	X		07/02/94
1,2,4-Trichlorobenzene	µg/l	1.0	X		07/02/94
1,1,1-Trichloroethane	µg/l	0.5	X		07/02/94
1,1,2-Trichloroethane	µg/l	0.5	X		07/02/94
Trichloroethylene	µg/l	0.2	X		07/02/94
Trichlorofluoromethane	µg/l	1.0	X		07/02/94
1,2,3-Trichloropropane	µg/l	2.0	X		07/02/94
1,2,4-Trimethylbenzene	µg/l	1.0	X		07/02/94
1,3,5-Trimethylbenzene	µg/l	1.0	X		07/02/94
Vinyl Chloride	µg/l	0.2	X		07/02/94
m- & p-Xylene	µg/l	1.0	X		07/02/94
o-Xylene	µg/l	1.0	X		07/02/94

Analytical No.: 14617

X = Analyzed but not detected.

REQUEST FOR SERVICES

303 W. MILITARY RD. ROTHSCHILD, WI 54474 1-800-338-SCAN

CLIENT INFORMATION

Name: Cyrus W. Ingraham
Company: Short Elliott Hendrickson Inc.
Address: 421 Frenette Drive
Chippewa Falls, WI
Phone: ( )
P.O. # / Project #: / WIDNR9401
Quote / Reference #: 2265-9
Note: Terms and conditions printed on back apply.

21-0412

Turnaround Time
- [x] Normal
- [ ] Rush

Date Needed
(Preapproved by Lab)

Sample Type
(Check all that apply)
- [x] Groundwater
- [ ] Wastewater
- [ ] Soil
- [ ] Solid Waste
- [ ] Oil
- [ ] Other

Sample Handling
- [ ] Nonhazardous
- [ ] Flammable
- [ ] Skin Irritant
- [ ] Highly Toxic
- [ ] Other (specify)
- [x] Refrigerate
- [ ] Work in Hood
- [ ] Wear Gloves

20014612 20014617

ANALYTICAL REQUESTS
(use separate sheet if necessary)

LAB USE ONLY	DATE	TIME	No. of Containers COMP	No. of Containers GRAB	SAMPLE ID	PAH SW846-8270	VOC SW846-8021	Cyanides, Total and Amenable EPA 335.1 + 335.3	TOC Apha method 505B	As, Al, Fe EPA method 200.9 + 200.7	REMARKS
	6-28-94	1:45		7	AW-1	/	/	/	/	/	Metals Sample Field - Filtered
	6-28-94	2:15		7	MW-3	/	/	/	/	/	"
	6-28-94	2:15		3	MW-3 Duplicate		/				
	6-28-94	2:45		7	MW-1	/	/	/	/	/	"
	6-28-94	3:30		7	MW-2	/	/	/	/	/	"
				3	Trip Blank - SP		/				

SHORT

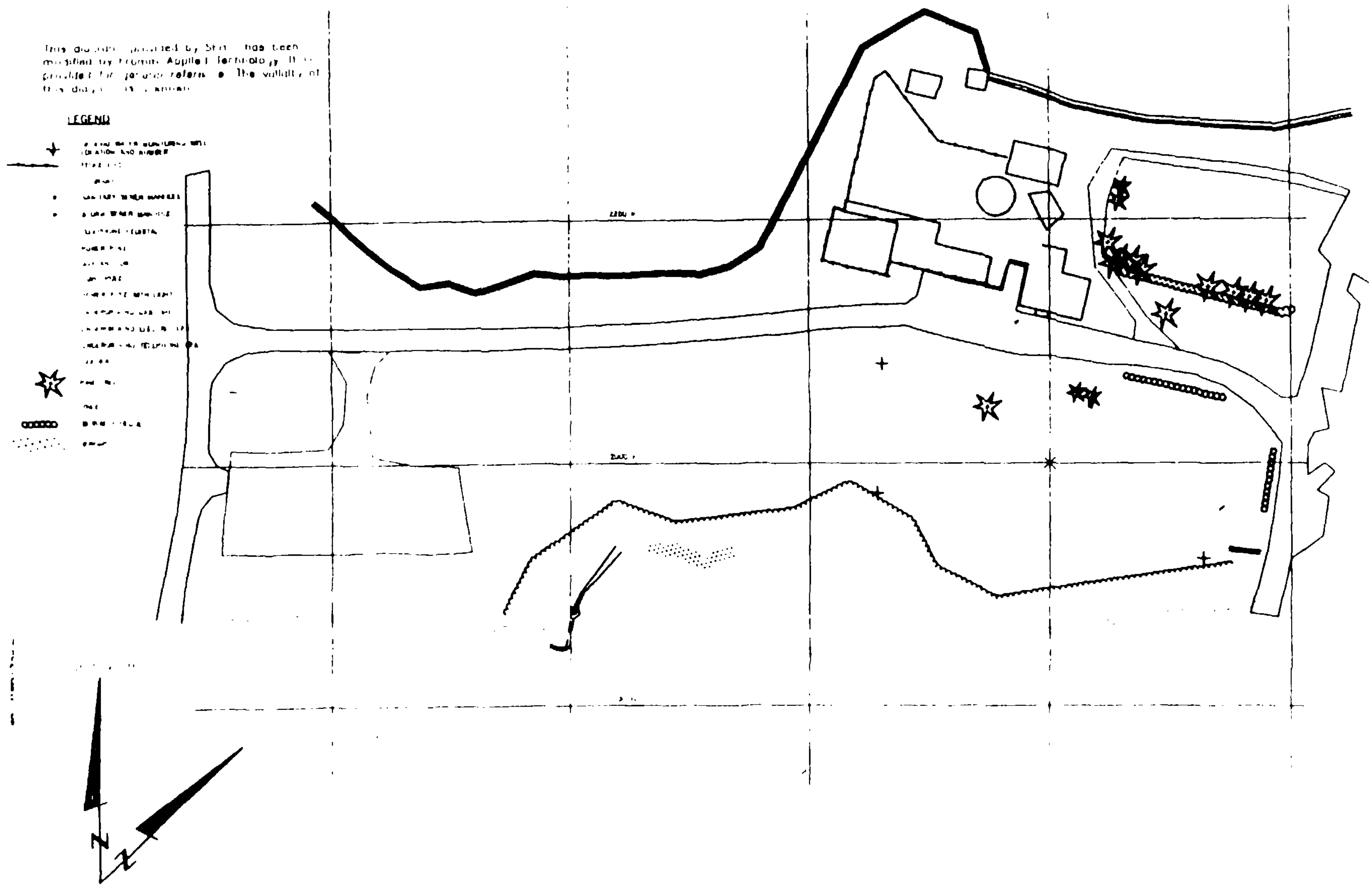
CHAIN OF CUSTODY RECORD

SAMPLERS: (Signature) John E. Gulf

RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED BY (Signature)
John E. Gulf	6-29-94 8:00a	
RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED BY (Signature)
RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED FOR LABORATORY BY: (Signature) Doris Putzman
		DATE/TIME 6/30/94 1:00pm

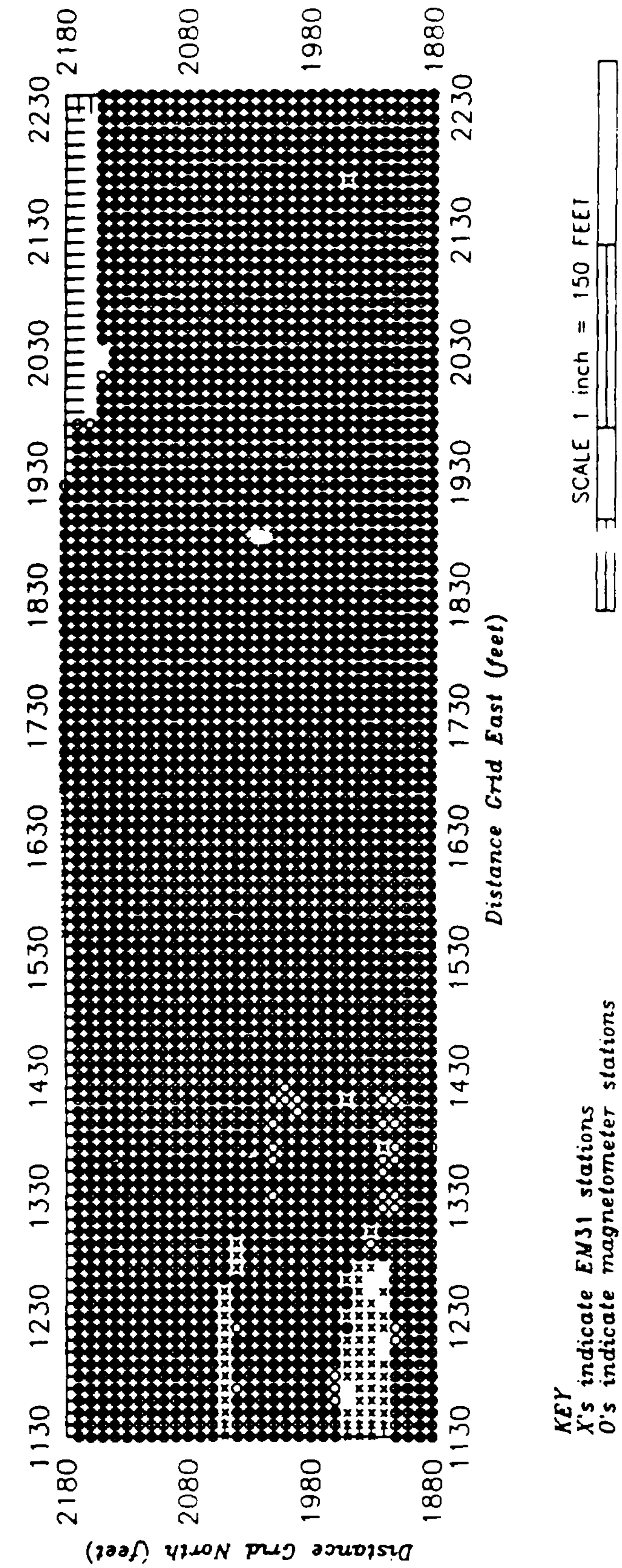
Del'v: Hand Comm
Ship. Cont. OK? Y N N/A
Rec'd Refrig.? Y N N/A
Seals OK? Y N N/A
Samples leaking? Y N N/A
Comments:

Rec'd on ice


LEGEND

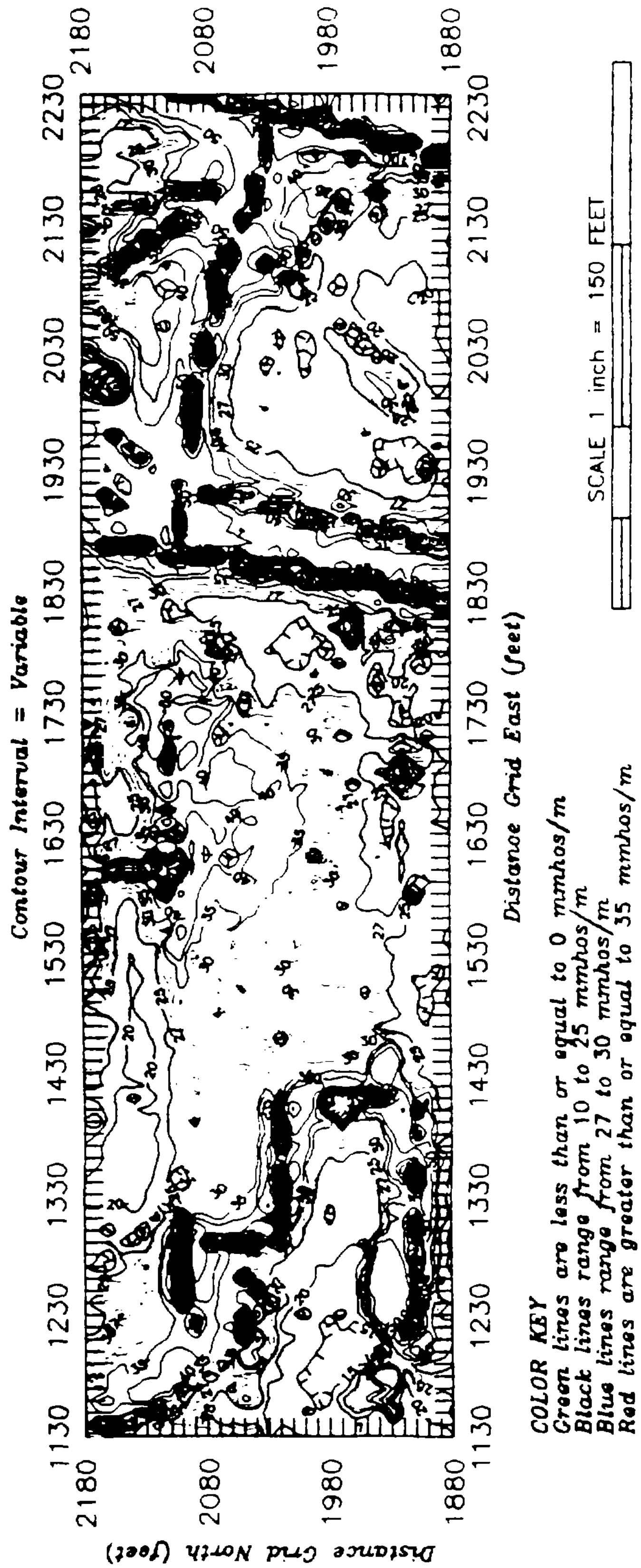
Fromm Applied Technology
13129 N. Green Bay Road
Mequon, Wisconsin 53092
(414)242-4280

Figure 2: Marina Drive Site--Occupied Geophysical Stations



Fromm Applied Technology
13129 N Green Bay Road
Mequon, Wisconsin 53092
(414)242-4280

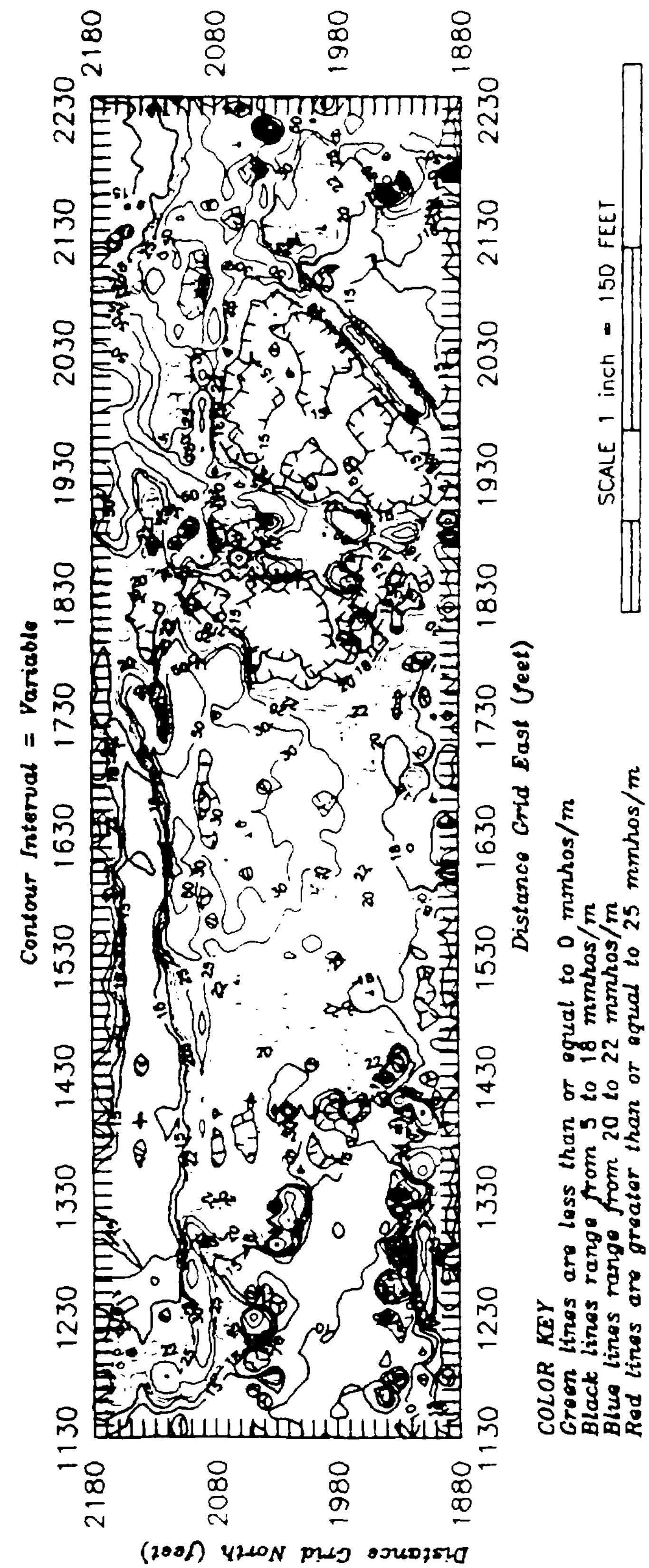
Figure 3: Marina Drive Site--Contour Map of EM31 Vert. Conductivities



Fromm Applied Technology

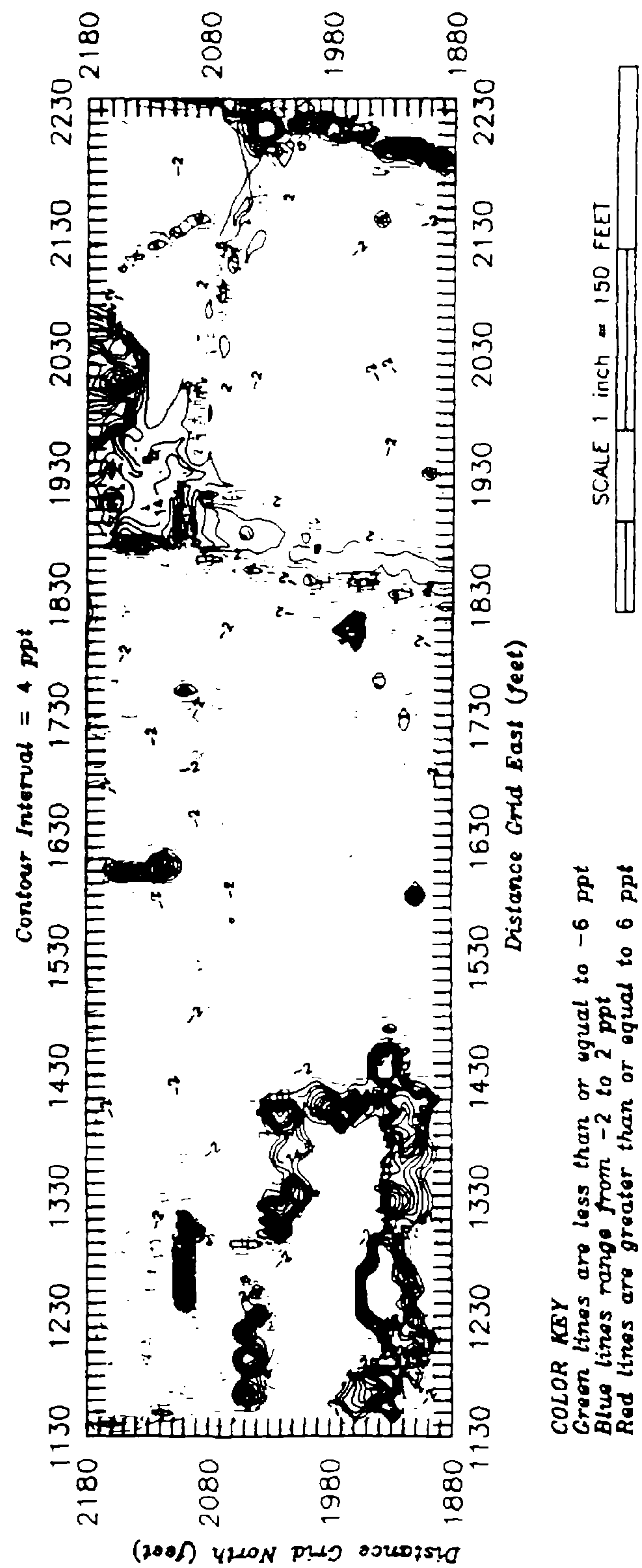
13129 N. Green Bay Road
Mequon, Wisconsin 53092
(414)242-4280

Figure 4: Marina Drive Site--Contour Map of EM31 Horz. Conductivities



Fromm Applied Technology
13129 N. Green Bay Road
Mequon, Wisconsin 53092
(414)242-4280

Figure 5: Marina Drive Site--Contour Map of EM31 Vert. Inphase Response



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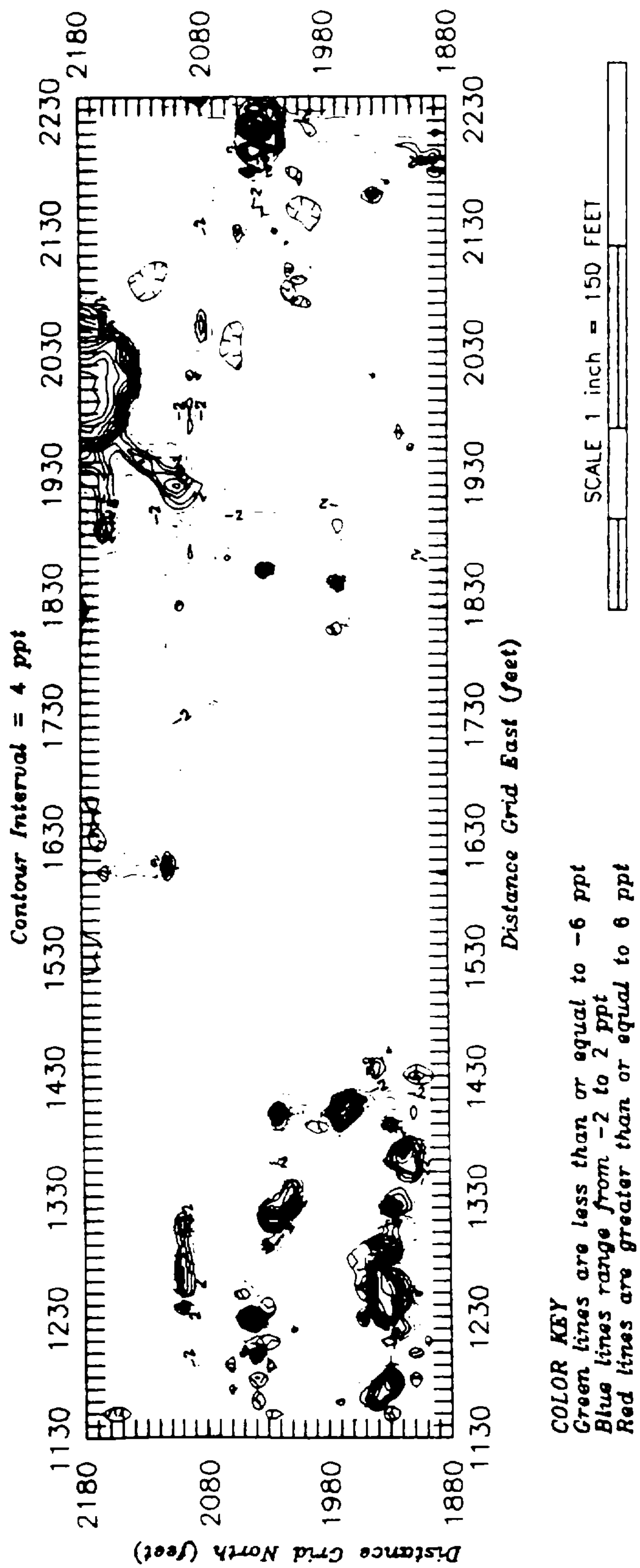
13129 N. Green Bay Road
Mequon, Wisconsin 53092
(414)242-4280

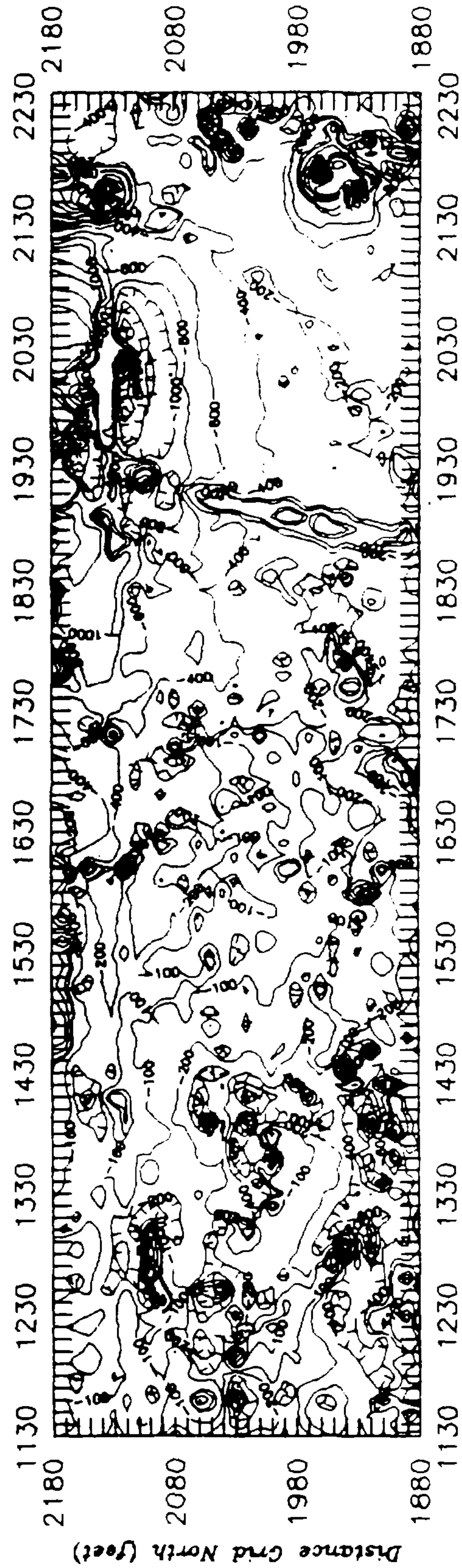
Figure 8: Marina Drive Site--Contour Map of EM31 Horz. Inphase Response



Fromm Applied Technology
13129 N. Green Bay Road
Mequon, Wisconsin 53092
(414)242-4280

Figure 7: Marina Drive Site--Contour Map of Residual Total Field

Contour Interval = Variable



SCALE 1 inch = 150 FEET

COLOR KEY
Green lines are less than or equal to −200 gammas
Red lines are greater than or equal to −100 gammas

Fromm Applied Technology

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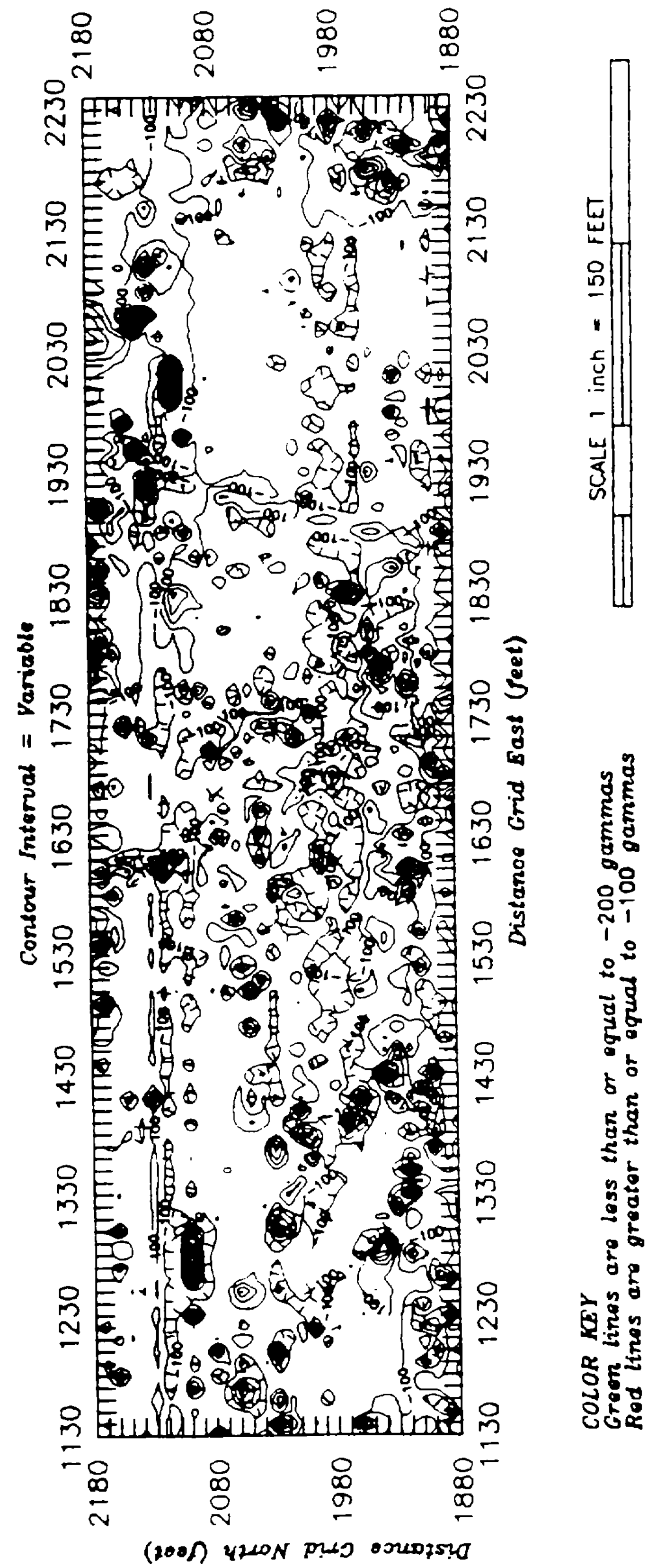
Figure 8: Marina Drive Site--Contour Map of Total Field Vert. Gradient



Appendix A: Overview of Electromagnetic Surveys

Overview of Electromagnetic Surveys

Electromagnetic surveys attempt to measure near surface electrical conductivity, the inverse of electrical resistivity, through electromagnetic induction methods. The basic instrumentation required to accomplish this is pictorially defined in Figure 1-A. A surface transmitter coil, Tx, is driven with an audio frequency alternating current. The magnetic field resulting from current flow in the transmitter coil causes induced currents to flow in the ground. The induced ground current creates a secondary magnetic field which can be sensed by a surface receiving coil, Rx. The surface receiving coil will also sense the primary magnetic field resulting from current flow in the coil Tx but this primary field lags the secondary field by 90 degrees. The phase shift between the primary and secondary fields provide a basis for their separation.

In general, the magnitude of the secondary field sensed by receiver coil Rx is a nonlinear function of the coil spacing, operating frequency, and surface conductivity. However, for selected values of operating frequency and coil spacing the magnitude of the secondary field is a linear function or the surface conductivity. Hence, if an appropriate frequency and coil spacing are utilized, the magnitude of the secondary field phase shifted by 90 degrees from the primary field can be used to imply the near surface conductivity. The magnitude of the magnetic field sensed by Rx and inphase with the primary field can also be measured. This is known as an inphase measurement and can be expressed in terms of parts per thousand (ppt) of the primary field.

The penetration depth of electromagnetic measurements is highly dependent upon surface conductivity. Under ideal conditions, the EM-31 equipment used in this study can achieve penetration depths of approximately 15 to 20 feet for normal conductivity measurements. However, the presence of surface metal can limit penetration to the surface. Thus, it is only possible to state that penetration depth can be as deep as approximately 20 feet and note that measured conductivities do not define a burial depth. A more conservative estimate for detecting buried metal is less than 10 feet. In comparison and also under ideal conditions, the EM-34 equipment implementing a 20 meter coil spacing can achieve penetration depths of approximately 45 to 100 feet depending on the orientation of the coils, horizontal or vertical. The presence of sporadic surface metal can limit penetration, but not usually as severely as the EM31. Thus and as it is with the EM31, it is only possible to state that penetration depth can be as deep as approximately 45 to 100 feet with a 25 meter coil spacing. Again, measured conductivities do not define a burial depth. With respect to metal detection, the instrument, EM34, is not usually used to locate buried metal, unless the burials are extremely large.

While electromagnetic measurements provide an excellent method for the detection of near surface metal objects, the measurements cannot define the type or form of metal involved. For example, conductivity measurements cannot distinguish between aluminum barrels, iron engine blocks, concrete with steel reinforcing rod, or steel kitchen appliances.

Metal within an electromagnetically surveyed area can be detected with either the conductivity measurements or the inphase measurements. Electrically conducting material, generally steel, within a few feet of the surface will cause electromagnetic field distortions which will result in zero or even negative values of measured conductance. Deeper metallic objects will cause less field distortion and lead to measured conductivities which are abnormally high in comparison to site background values. Inphase measurements are believed to be more sensitive to metal than conductivity measurements. Thus, inphase anomalies may indicate the presence of metal at too great a depth to effect the conductivity measurements. Hence, metallic objects within the confines of a survey area are characterized by one or more of the following:

1. Zero or negative conductivities.

2. Conductivities abnormally high or low for site soils.

3. Anomalous inphase values.

Appendix B: Overview of Magnetic Surveys

Overview of Magnetic Surveys

The magnitude of the earth's magnetic field varies over the surface of the earth for a number of reasons. Short wavelength spatial variations of the field which occur within tens of feet are always due to the presence of ferrous metal, assuming the absence of power lines. Hence, the detection of short wavelength spatial variation in the earth's field is a certain indication of the presence of ferrous materials.

The magnitude of the earth's magnetic field may be measured with various types of instrumentation. This study employed a proton procession magnetometer which measures the magnitude in gammas of the earth's total magnetic field. Because only spatial variations are of concern, all measured values are adjusted to the value of some particular measurement point within the survey area. This reference point is known as the base station. Reported values are the magnitude by which the total field at a particular location is above or below the total field at the base station.

In addition to the magnitude of the field, the vertical change in the field per unit vertical distance can also be measured with the available magnetometer. This quantity, known as the vertical gradient, is related in part to the distance of the measurement point from the ferrous material. As the distance from the ferrous material increases the vertical gradient will decrease. Thus, assuming the equality of other factors, vertical gradients which are high in comparison to background gradients are indicative of very near surface ferrous material.

The exact shape of a total field or gradient anomaly over ferrous material is highly dependent upon the geographic location, the direction of the survey line, and the geometry of the ferrous material. Thus, it is difficult to spatial identify the source area of most magnetic anomalies, typical found in the field. However, observed anomalies should generally be characterized by a central positive peak partially surrounded by flanking negative values. The exact location of the ferrous material is generally associated with the point of zero crossing or the zero contour line. Because it is difficult to define a typical magnetic anomaly it is also difficult to define a magnetic depth of investigation. For a general point of reference, a 1000lb steel sphere could be detected at a depth of approximately 60 feet if there was no surface metal above the sphere. The lack of any surface metal is critical as it is generally not possible to detect the presence of buried metal beneath surface metal.

In summary, magnetic measurements are only effected by the presence of ferrous material and are generally independent of topography or site soil conditions, assuming that most native soils do not contain a significant amount of material with high magnetic susceptibilities. The detection range of magnetic measurements exceeds that of other geophysical methods so that grid spacings can be increased in comparison to other methods. The drawback of magnetic measurements is that they are strongly influenced by surface metal, including metal tens of feet to the side of the measurement point, and the exact location of detected metal can be difficult to predict.

Appendix D

Analytical Results

Appendix E

Standard Protocols

Protocol for Excavation Sampling and Investigation of Subsurface Soils – Backhoe

A backhoe is used at the site for excavating surface and subsurface soils from specific locations. This provides for visual observation of subsurface conditions, and allows for collection of soil samples at depth. Excavated soils are loaded directly onto trucks for transport to a landfill or treatment facility. When possible, "clean" soils are kept separate from contaminated soils and all "clean" soils are used as backfill for the final excavation. Clean offsite granular soils are used as backfill for the excavation after sampling is performed.

Soil samples are generally collected from varying depths to obtain representative samples. A grab sample of soil is extracted from the excavation using the backhoe bucket, and the bucket is then placed on the ground surface next to the excavation. A sample is collected from the bucket using decontaminated stainless-steel sampling equipment. Visual observations are made of the test pits during excavation activities, and soil samples are classified in the field by SEH's Site Representative. Sample lithology is recorded using the Unified Soil Classification System. Soil test pit logs, documenting soil types and subsurface conditions, are completed by the Site Representative.

During excavation and sampling activities, soils are screened for the presence of volatile organic compounds (VOCs) using a photoionization detector (PID) or flame ionization detector (FID). VOCs are common components of a variety of environmental contaminants, including industrial solvents, petroleum products and wide range of other industrial compounds. The PID and FID are also used to monitor ambient air concentrations at the excavation and within the work zone during the soil excavation, in accordance with SEH's Site Safety Plan. Personal protective equipment is utilized by sampling personnel during sampling, as specified in the Site Safety Plan.

Soil samples are obtained from the central portion of each bucket, and not from areas near the bucket surface. Stainless-steel sampling equipment used to collect the soil sample from the bucket is decontaminated between samples using a soap and water wash followed by a distilled water rinse.

Soil samples are collected in laboratory-clean glass sample jars. These are labelled with the sample designation, location, date, time and sampler. Sample collection and preservation procedures will follow the latest WDNR LUST Guidance protocol. Collected samples are preserved on ice and shipped to the contracted analytical laboratory. SEH standard chain-of-custody procedures are followed regarding the shipment and receipt of samples.

Soil Vapor Monitoring – FID

Soil vapor (headspace) measurements are made on soil samples collected by soil boring, test pit and pipe trenching activities. The field instrument used is a Foxboro Organic Vapor Analyzer (OVA) Model 128 portable flame ionization detector (FID) that has been laboratory calibrated. The FID is calibrated in the field using 100 ppm methane prior to conducting any sample measurements. This instrument provides the following analytical screening capability:

Accuracy:	Based on the use of a calibration gas with operating temperatures between 10 and 40 degrees C. within +/- 20% for 0 to 10 ppm within +/- 20% for 0 to 100 ppm within +/- 20% for 0 to 1000 ppm
Response Time:	Approximately 2 seconds for 90% of final reading
Detection Limit:	0.2 ppm methane
Response to Petroleum:	Recorded as meter deflection based on the above referenced calibration.

The following procedure is used in determining headspace gas concentrations in each soil sample:

1. Half-fill one clean sealable plastic bag with the sample to be analyzed and immediately seal. Plastic bags are 10 oz. volume capacity.
2. Headspace is allowed to develop for 10 minutes. The bag is vigorously shaken for 15 seconds both at the beginning and end of the headspace development period. Where ambient temperatures are below 32° F (0° C), headspace development is conducted within a heated vehicle or building.
3. After headspace development, the plastic bag is punctured with the instrument sampling probe to a point about one-half of the headspace depth. Care is exercised to avoid uptake of water droplets or soil particles.
4. Following probe insertion through the plastic bag, the highest meter response is recorded as the headspace concentration.

Samples are also examined visually by an environmental professional for staining or other signs of contamination.

Laboratory Soil Sample Handling

Soil samples are collected for laboratory analyses at selected intervals using clean stainless steel or disposable plastic utensils and placed in clean glass jars provided by the testing laboratory. Soil is either weighed (per WDNR Guidance) or used to completely fill the laboratory sampling jars. Samples are then immediately placed in a cooler on ice. All sampling utensils are either disposed of (plastic) or cleaned using a detergent-water mixture and triple rinsed with distilled water. Soil samples are then repacked at the office and sent to the laboratory for analyses following chain-of-custody procedures.